THE BASIS OF PSYCHIATRY

Section of Cerebellum from Acute Encephalitis hemorrhagica (Erysipelas).
(See fig. 79)

THE BASIS OF PSYCHIATRY

(PSYCHOBIOLOGICAL MEDICINE)

A GUIDE TO THE STUDY OF MENTAL DISORDERS FOR STUDENTS AND PRACTITIONERS

BY

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79 ILLUSTRATIONS

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TO

THE MEMORY OF HIS FATHER

WILLIAM C. BUCKLEY, M.D.

UNDER WHOSE TUTORAGE THE AUTHOR
WAS STIMULATED TO SEARCH FOR THE
CAUSES OF DISEASE IN LIVING PATHOLOGY

PREFACE

As the domain of general medicine in recent years has become considerably broadened, and many of the newer facts have been brought to light through the channels of Biology, and as the field of "traditional General Physiology" has become more or less fully occupied by Experimental Biology, so the mode of approach to the problems of Psychiatry is following similar trends. This change in the direction of approach to psychiatry has come about through the development of a closer relationship between the subjects of biology and psychology; in fact, the two branches of science overlap to the extent that in the study of many problems it is difficult to determine where the one begins and the other ends, for the reason that it is but the same "science" viewed from different aspects.

The statement in a text-book on psychology that "Psychology is the science of behavior" presents one of the striking evidences of the change in point of view of the psychologist, which is steadily developing and is becoming more widely accepted.

As physicians and practitioners we have come to consider the group of mental disorders which belong to the class of recoverable psychoses not primarily as mental diseases, but as reflections of some bodily disorder, which, through its effect upon the organ of adjustment—the nervous mechanism and its lower and higher (psychic) reflexes—prevents the patient from making appropriate adaptations to environmental conditions, and therefore constitutes a thoroughly biological problem.

The reactions of the patient as a whole individual form the subject underlying every problem in psychiatry. In order to solve the question there must be an examination of all bodily functions before an intelligent conclusion can be reached from the standpoint of diagnosis, prognosis and treatment of the mental condition.

In the present work there has been an attempt to present to the student of psychiatry, the practitioner of medicine and others interested in the disorders of adjustment, an arrangement of the subjects in a concise form, yet embracing a sufficient number of biological and psychological data to indicate the course which this viewpoint requires us to follow.

As a method of approach to the study of psychiatry the present mode of presentation has been found useful to the writer. The principal reasons for this lie in the fact that the student may be led to feel that he is entering that which for him is more or less untrodden ground, through paths with which he is comparatively familiar; furthermore, the biological introduction seems to be a logi-

cal and nearer approach to a practical route to the study of psychiatry, as it is to medical subjects in general.

The matter contained in the present work is an outgrowth and an elaboration of material collected from many sources for presentation in lecture courses and clinical instruction to students and others during the past twelve years, and from the results of clinical experience.

The writer acknowledges gratefully his indebtedness for the aid he has been fortunate to obtain in the compilation of the portions of the work on biology and psychology. The author is especially indebted to Professor Edwin G. Conklin, who read the chapters on Biologic Phenomena and on Mental Development, for his advice and suggestions in regard to the arrangement of the matter on the Mechanism of Inheritance.

To Dr. Clara H. Town, who read the chapter on Psychological Processes, and to Dr. Charles K. Mills, who read the portions dealing with Cerebral Development and Localization, obligation is herewith acknowledged for many valuable suggestions. For numerous helpful criticisms the writer is indebted to his sometime hospital chief, friend, and adviser in matters of practical psychiatry, Dr. Robert H. Chase, whose interest and encouragement have been much appreciated.

Acknowledgment is herewith also made to works on Psychiatry which have been consulted freely, especially those of Tanzi, Bianchi, Regis, Kraepelin and Janet; in Psychology to the works of Wundt, Höffding, James, Ladd, Tichener, Pillsbury and Judd, and in Biology, the text-book of Hertwig and the writings of Wilson, Morgan, Conklin, Johnston, Patten, Loeb, Jennings and Parker.

It has been the writer's aim in every instance to give the references to the sources of material cited from the current literature with the view of recognizing due credit, as well as for the guide of the student who desires to seek further information upon the subjects discussed.

The clinical aspects of psychiatry are discussed on as broad lines as could be made consistently, and include, at the same time, the more important reaction types met in every-day clinical experience. The consideration of purely agenetic types, or defective groups, such as idiocy and imbecility, has been purposely omitted.

For the reader's convenience a glossary of biological, psychological and psychiatric terms is appended.

Frankford. THE AUTHOR.

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PART I

CHAPTER I

INTRODUCTION—HISTORICAL

PSYCHIATRY occupies a large part of the field of general medicine. It has as its subject-matter the study of the causes and symptomatology, and as its object the treatment of diseases the most prominent symptoms of which manifest themselves in disturbances of the functions which constitute the psychic operations commonly termed the *mental processes*. Psychiatry attempts to determine practical means for the prevention of mental disorder or defect, and for restoring the disordered mental functions to their normal standard. In many instances this involves the treatment of an accompanying or even causative physical disease, or it may call for the direct influence of the disordered mind by making new and more wholesome impressions upon it, or, as is usually the case, it requires the application of both physical and mental therapeutic measures. Psychiatry is often spoken of as *psychological medicine*, for the reason that its problems are both medical and psychological.

On account of the fact that psychiatry is intimately interrelated with all the fundamental sciences allied to medicine, including in a special manner general biology, and because it demands the cooperative efforts of workers in clinical and laboratory fields, the anatomist, the physiologist, the bio-chemist and the psychologist, its scope is progressively widening in consequence of added light contributed by researches in their respective spheres.

The intrinsic complexities of the nervous system and its, as yet, largely unexplained physiological and pathological problems appear at first as obstacles great enough to deter one from fruitful study of psychiatry. This, however, might be said to be as groundless a view as that of the one who might believe that because the nature of the forces of the universe are not known except by their effects, the efforts of the chemist and of the physicist are of no avail for the utilization of those forces to the practical advantage of the populace.

It is scarcely more than a hundred years since psychiatry became recognized as an important part of general medicine. Within the last twenty-five years the greatest progress has been made, and the study of the causes and treatment of mental disorders has been proceeding along rational lines, so that mental medicine has kept pace fairly well

with advances in general medicine. In recent years there has been brought forth considerable evidence in favor of the belief that many mental disorders are of toxic origin. Though there is still much to be determined with respect to that phase of the subject, it is now firmly established that there is no fundamental difference between the pathological problems of the psychiatrist and those presented to the observer in general medicine. The pathology of mental disorders cannot be regarded as confined to the organ within the calvarium any more than the pathology of cardiac affections can be considered to be limited to the pericardial sac and its contents. It must follow, therefore, that mental disorders are to be studied from a point of view which occupies a position in a field not limited within the psychic sphere, and that mental symptoms are often manifestations of somatic disease or disorder.

Many of the problems of internal medicine are approachable from a biologic standpoint. Stimulated by studies concerning animal behavior, such as those more recently by Loeb, Jennings, and others, there has been developed an attractive point of view from which the pathological as well as the normal activities of living beings can be investigated with profit. To the student of psychiatry this biologic approach should appeal strongly because of the fact that the sciences of biology and psychology are coming nearer and nearer to occupy a common ground, each lending support to the facts which serve to elucidate the phenomena of the other order, and also for the reason that this point of view can consistently hold that mental phenomena, both in health and disease, are representatives of the **biological reactions** of the individual as a whole, rather than that of any particular organ or group of organs.

The problems of psychiatry especially demand careful consideration of all the possibilities concerned in the question of the relation of cause and effect, particularly in an attempt to estimate the value of factors concerned in the production of mental disorders.

At one time in the history of the study of mental disorders the psychic or so-called "moral" causes were considered fully adequate and therefore responsible for the occurrence of the mental disturbance. With an increase of knowledge of the minute anatomy of the brain, together with the information obtained by the study of neuropathology, especially with regard to the effects of cerebral lesions upon motion, sensation, speech and thought, there arose the belief that physical changes in the brain were chiefly responsible for mental disturbances. At the present time neither of these extreme views is regarded as containing all the truth. Etiologic factors of mental disorders are to be sought among causes of both psychic and somatic origin.

Students of medicine have come to agree, largely as the result of the lessons learned from biology, that the causes of disease included under the term "predisposition" are representative of nega-

tive factors rather than active causative agents. This may indicate an absence of some necessary factor, which means inability to carry on function in a normal manner. Predisposition is indicated by the fact that one individual, having either inherited or acquired a greater deficit in a given potential, will require less of an exciting factor to interfere with normal function or give rise to a condition of abnormal function.

In the domain of mental medicine great difficulty is often met when one attempts to estimate etiologically how much of the disturbance is due to inherent defect and how much to factors outside of the nervous system.

The satisfactory grouping of mental disorders into classes is difficult though desirable. The need for some classification is twofold: one, a requirement which has a largely scientific basis, which may or may not satisfy the demands of the clinician; the other, partly scientific, and for practical purposes the most important, involves the prognostic side of the problem. In any event, the problem calls for an estimate of the nature of the malady and resolves itself into the differentiation of the "**reaction types,**" as the biologic viewpoint would have it expressed.

All organisms are endowed with certain attributes which they have inherited from their progenitors, among which is the ability to more or less "dominate over environment," for meeting which task the individual must be able to make suitable adjustments. Furthermore, situations are constantly arising which call for readjustments to meet new conditions. Among the lowest forms of animal this adaptation is made by physical and chemical means. In the higher forms of animal and in the highest type of organism—the human organism—are concerned not only the same physiologic functions for the adjustment and defence of the individual, but also the added functions of a nervous system which is the mechanism designed to aid in the necessary reactions for the adjustment of the organism as a whole, to which are added psychologic attributes which are largely concerned in the process of adjustment. The interrelation between the emotional states and the functions of muscles and glands furnishes one of the many problems which the student of modern psychiatry has to meet; the disturbances of digestion shown as anorexia, regurgitation of food, intestinal indigestion, disturbances of metabolism and of nutrition, are conditions commonly met as accompaniments of nervous and mental disorder, especially in the types which are marked by profound disturbance in the emotional sphere. In disordered emotional states, more or less fixed, abnormal reactions and attitudes are assumed by the individual; the abnormal reaction often has the appearance of being an attempt at adjustment—an attempt which may overstep the mark or may fall short. In any event, it is a maladjustment which manifests itself as a psychic disorder, a psychosis or a neurosis, with or without gross physical disturbances.

Viewing the nervous mechanism as the organ of adjustment, and as a means by which not only organs and systems are governed, but also the organism as a whole is brought into adjustment with environment, the problems of psychiatry must be approached, in part at least, from the biologic viewpoint.

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CHAPTER II

BIOLOGIC PHENOMENA

THE phenomena by which the living are distinguished from the non-living things include the protoplasmic activities known as metabolism, growth, motion, reproduction, irritability and conductivity.

As the result of observations in biologic fields, it has become a well-established fact that these vital characteristics represent the various modes by which organisms respond to external influences, and may be included within the meaning of the term **reaction.**

Most of these vital phenomena may be observed in the simplest organisms as the physiological characteristics of a single cell, as in the various protozoa. At least three of these functions, namely metabolism, irritability and reproduction, are essential for the maintenance of the "dynamic equilibrium" characteristic of living protoplasm.

Reaction may be said to be the expression of inherent organization whereby activity follows stimulation of any part of an organism as may be demonstrated in such unicellular organisms as amœba, or vorticella, and in the lower metazoa, such as sponges.

In higher forms of metazoa the mode of reaction is less direct and often depends upon the application of the stimulus to a particular part of the organism which has become specialized during the process of development for the reception of external stimuli, and in which case there is provided a structural mechanism in the form of a nervous system for the coöperation of the entire organism in responsive reaction to changes of environment.

Organisms are endowed with an inherent ability to select and appropriate suitable food-materials; also to avoid or reject materials which may be harmful or even unsuited to their needs and useless as food. By metabolic processes food-materials are assimilated and become an integral part of the organism, so that the individual grows by the growth of all of its parts. Furthermore, the organism may be capable, under proper stimulation, of changing its shape, and it may change its position with reference to other objects (Fig. 1); that is, it is capable of motion and locomotion.

Under suitable conditions certain kinds of stimuli may be followed by contraction of the protoplasmic mass, or by a process of budding, either of which phenomena may give rise to the division of the body of the organism into two or more parts, each constituting an individual possessing or developing characteristics like the parent which has thus reproduced its kind.

By virtue of inherent **organization,** the organism is able to select its food without specialized sense organs, to digest food without secre-

tory cells, to distribute food materials without a specialized circulatory apparatus, to move its body without muscle cells, and to reproduce its kind without specialized sex cells.

Furthermore, the *simplest organisms are devoid of nerve elements.* Their life cycle can be completed as the result of organization whereby reactions occur without the aid of specialized structures or apparatus for the reception and coördination of the effects of external stimuli.

Among metazoa, which consist of aggregations of cells, there is a differentiation of cellular elements to subserve separate functions. Similar vital functions are carried on as in the lower forms of organisms by means of vital processes which individually are probably no more complex than the corresponding functions in one-celled organisms, but which differ chiefly in the fact that a "division of labor" has been

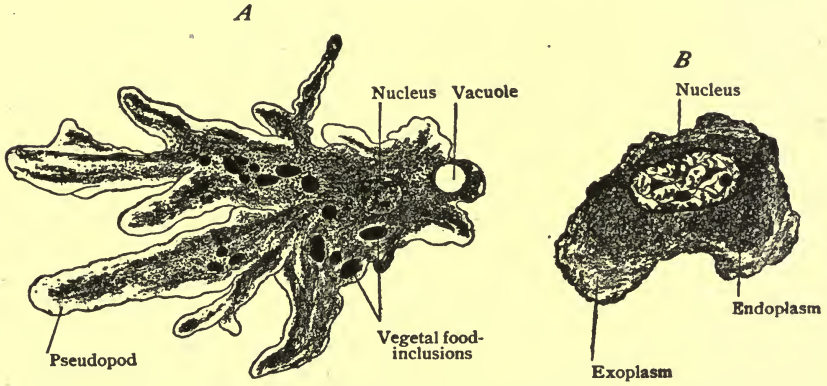

FIG. 1.—*A*, unicellular animal (*amœba*); *B*, embryonal cell—leucocyte. (*Piersol.*)

brought about through cell differentiation. In the lower forms of multicellular organisms, as in porifera (sponges), collections of cells live as independent organisms, but at the same time as a mass or colony of cells constituting a *soma* in which a certain amount of differentiation of cells and of cell layers has taken place. Cells are provided externally for protection; cells arranged internally subserve the functions of digestion and distribution of food materials; simple muscle cells are differentiated by means of which the body apertures are opened and closed. Notwithstanding this well-marked differentiation in sponges, there are no specialized cells for the reception of external stimuli and no evidence of nervous elements. According to Parker,[1] the opening and closing of the oscula take place as the result of contractile response to stimuli brought about in the muscle cells by the movements of the sea-water in which the animal lives.

The Development of the Nervous System.—As the phylogenetic scale advances, the development of the nervous system is distinctly progressive. According to Gaskell,[2] the nervous system has been the dominant factor in evolution, shown by the fact that the functions of

the other systems have undergone modifications to favor the development and growth of the nervous apparatus. Several types of nervous system may be distinguished, each one presenting a greater degree of complexity than the preceding type. The types of nervous system which bear distinguishing characteristics are the **diffuse**, the **linear**, the **ganglionic** and the **tubular.**

The Diffuse Nervous System.—The first attempt at differentiation of special structural elements which serve the purpose of sensory organs is found in cœlenterates in the form of modified ectodermal cells. With this differentiation of the ectodermal elements appears the diffuse nervous system which is the simplest form of nervous

FIG. 2.— Diagram of a complex type of receptor-effector system. *r*, receptor; *m*, muscle cell; *g*, ganglion cell. (*Parker.*)

FIG. 3.—Diagram of simple sensory-motor system of sea anemone. Sense cell or receptor (*r*) whose basal nerve-net connects with the muscle cell (*m*). (*Parker.*)

apparatus, as found in hydras, corals and hydroid polyps. The nervous system in these organisms is composed of nerve cells and nerve fibres distributed throughout the body but chiefly in the ectoderm, appearing as a delicate subepithelial network of fibres and ganglion cells [3] (Fig. 2). The nerve cells and fibres are arranged with little or no reference to anatomical structure and without structural coördination, as is apparent when one compares the activities of the hydroids with those of animals with central nervous systems. In some hydras the epithelial cells are continuous with contractile prolongations attached to their inner ends which are called into activity by stimulation of the outermost portions. There is, therefore, no reflex arc because of the continuity of the sensitive and the contractile substances (Fig. 3).

In hydroids the ectoderm gives rise to protective cells with processes, sense cells, muscle cells and sex cells. These ectodermal elements are the most important from the standpoint of the animal's activities in that they permit of varying degrees of sensitivity and motility. The protective cells which serve also as defence cells are specialized ectodermal elements in the form of ovoid sacs (nematocysts) with hair-like processes, the cnidocils. When these appendages are brought in

contact with an external object the fluid contents of the sac are discharged, which serves to poison or paralyze the animal's prey. Similar defence organs (trichocysts) occur in some paramecia, but little is known concerning their method of discharge. Although

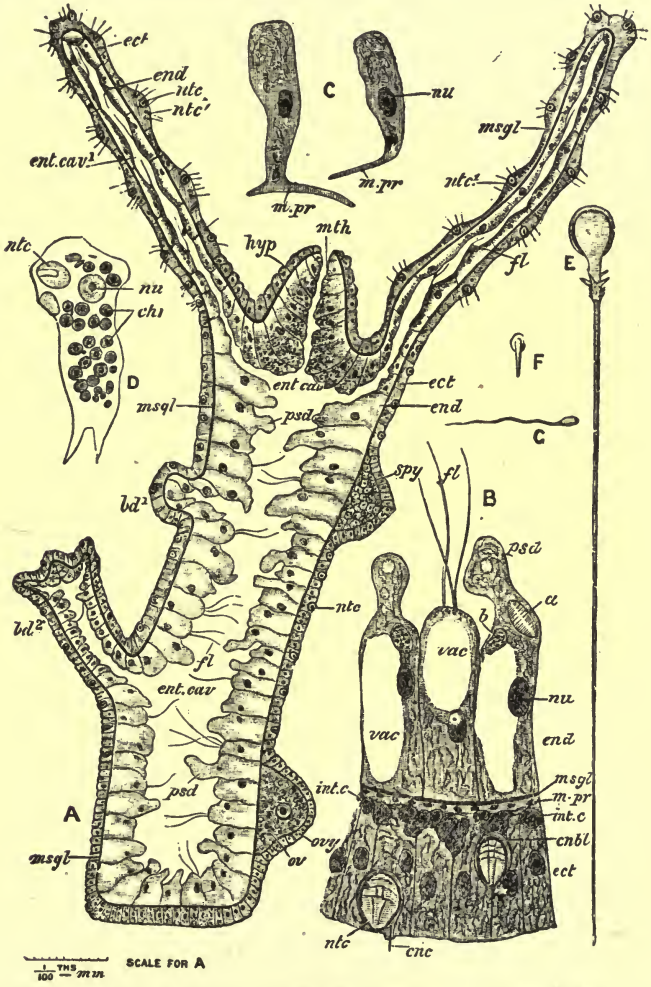

FIG. 4.—Diagram of Hydra. (*Parker and Haswell.*) (Courtesy McMillan Co.)
(*A*) Section of the entire animal. (*B*) portion of transverse section. (*C*) Two large ectoderm cells. (*D*) Endoderm cell of H. viridis. (*E*) Large nematocyst. (*F*) Small nematocyst. (*G*) Sperm.

these stinging cells are not sensory and are not nervous, as can be shown by the fact that they can be made to discharge mechanically or chemically after removal from the body of the animal, it is nevertheless significant that they should occur in such numbers in animals with the diffuse nervous system. This type of nervous system is inadequate for the coördination of the organism as a whole in its reactions to environmental changes, hence the need for added

means of defence, which in the higher animals is taken care of by an integrated nervous system.

The primitive sensory cells in hydras, sea-anemones and similar organisms, are concerned largely, and in all probability wholly, with the function of calling forth muscular movements, and therefore stimulate activity rather than furnish information as occurs in the higher types of animals. According to Parker,[4] these sense organs serve as a "series of local triggers to set off muscular activity in various parts of the body as needed" (Fig. 4). The same observer has shown that in the case of the sea-anemone, if a tentacle is removed from the animal, the tentacle will continue to entangle food and will turn in the direction which would correspond to the position of

FIG. 5.—Diagram of Medusa, showing nerve ring. (*Redrawn after Hertwig.*) (Courtesy Lea and Febiger

the oral aperture, as if the tentacle were delivering food to the mouth. Parker has also shown that normal locomotor movements will continue after the pedal disk of the anemone has been severed from the upper part of the body. Both experiments demonstrate the ability of one part of the organism to continue its function after separation from the greater part of the nervous system, for the reason that each part contains the necessary nerve and muscle apparatus. In experimental feeding of sea-anemones, if the tentacles of one side only are called into activity, these will cease to take food after a time, although they are not fatigued. If tentacles on the opposite side of the mouth are brought into use feeding is resumed as if no food had been taken by the animal. Parker concludes as the result of experiment with *Metridium,* that the sole function of the sense cells serves to call forth muscular movements, and that only in animals with a central nervous system "the sense organ has added to its primitive

function of calling forth muscular activity that of supplying messages to a growing central organ that has become of such permanent importance in man." Sensations are therefore to be associated with later phases of nervous development, inasmuch as muscular activity precedes nervous origins, *e.g.,* in sponges, and nervous tissue appears in consequence of the presence of muscles.[5]

The Linear Nervous System.—The linear type of nervous system is characterized by the arrangement of aggregations of nerve cells which furnish concentration points for the conduction of stimuli. In medusa forms of cœlenterates, for example, hydro-medusæ (jelly-fish), muscle cells are more distinctly differentiated. This renders the animal capable of greater activity than that possessed by hydroids, shown by complex movements as occur in swimming. The medusa possesses at the base of the membrane or velum, around the margin of the body, collections of cells and fibres resembling the characteristic neurons of the higher animals, representing the first step in the formation of a concentrated nervous system (Fig. 5). Here also are to be found the sensory cell, the nerve cell and the motor cell (Fig. 6) which permit the reinforcement of environmental changes and the propagation of the excitation through a nerve network in the body, and muscular reactive movements which occur at the end of the functional chain.

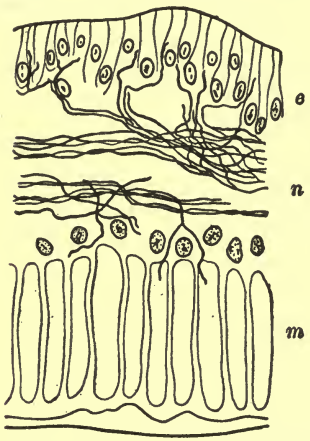

FIG. 6.—Section at right angles to the sphincter of the bell of *Rhizostoma;* the subumbrellar surface is uppermost; *e,* epithelium of the subumbrellar surface; *n,* nervous layer; *m,* muscle layer. (After Bethe, 1903.)

Similarly in some echinoderms (star-fish), there is an attempt at structural coördination of nerve elements. The nervous apparatus consists of a central ring of ganglia and nerve fibres from which five peripheral nerves extend radially and terminate in the points of the arms of the star-fish in a pigmented "compound eye-spot," colored with red or orange pigment which is sensitive to light.[6]

The Ganglionic Nervous System.—More clearly coördinated, both anatomically and physiologically, than any of the preceding types, is the ganglionic nervous system which occurs in worms, mollusks and arthropods. Two or more ganglia composed of groups of nerve cells and nerve fibres, connected by commissural fibres, constitute the central nervous system, from which extend laterally the peripheral nerves (Fig. 7). The ganglia may be arranged in pairs or singly. In this type of nervous system the central apparatus is distinctly separate from the epidermis and occupies a position in the supporting tissues in the interior of the body of the animal. The most constant paired ganglia lie dorsally and above the pharynx, constituting the supraesophageal

or cerebral ganglia. Other ganglia when present are placed ventrally below the digestive canal. The most primitive ganglionic nervous system occurs in Plathelminths (flat worms), which are characterized from the standpoint of the nervous system by the absence of the abdominal chain of ganglia. Strictly, the nervous system of the flat worm represents a transition type between the true ganglionic and the linear types.

In turbellaria a condensation of nervous elements lies in the region of the head on each side of the midline; these constitute the cerebral ganglia. From the ganglia a pair of nerves extend along each side of the ventral line to the caudal end of the body.

In some flat worms eye-spots are developed in connection with the ganglia.

In trematodes and cestodes the nervous system reaches a higher degree of development, both in respect to size of the ganglia and complexity of the nerve plexuses.

In typically segmented worms (annelids) several pairs of ganglia are arranged in ladder fashion by means of the interganglionic commissural connections.

In some annelids the cerebral ganglia present a lobulated arrangement, usually in three portions: an anterior pair from which nerves arise to supply the palps, a middle pair supplying antennæ and eye-spots, and a posterior pair of lobes from which spring nerves for other sense organs.[7]

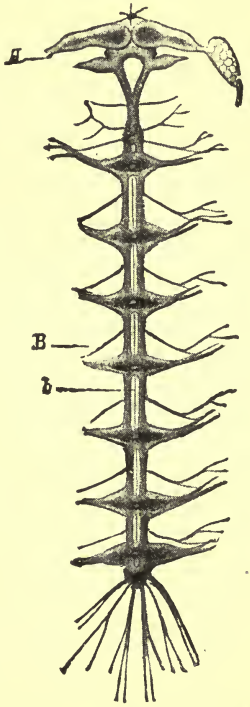

FIG. 7. — Ladder nervous system of Sow-bug. (*Kingsley's Hertwig.*) (Courtesy Henry Holt Co.)

Animals with segmented bodies and jointed extremities (arthropods) possess nervous systems still more distinctly coördinated. Each ganglion sends nerve fibres to a corresponding body-segment, and each ganglion may act independently of the other with which it is connected. This is true of both branchiata and tracheata (Figs. 8 and 9).

Patten has shown that the nervous system of *Limulus polyphemus* (horseshoe crab) is distinctly segmental both in structure and in function. Limulus possesses large supraesophageal ganglia and a chain of six smaller abdominal or ventral ganglia. Patten was able to demonstrate the course of impulses and to locate the centres which govern the activities of the animal. By removal of certain parts of the nervous system such impulses as gustatory, chewing and swallowing, respiratory reflexes, locomotion and the function of equilibration were iso-

lated. Patten regards the large ganglia, which he calls "hemispheres," as true cerebral centres, and similar to the primitive hemispheres of vertebrates. From a study of the arthropod, of which Limulus is the oldest representative, Patten concludes that this animal is the direct forerunner of the vertebrates [8] (Fig. 10).

The Tubular Nervous System.—The tubular type of nervous system is found in animals belonging to the phylum **chordata**, and also in members of the larger subphylum **vertebrata**, the structural charac-

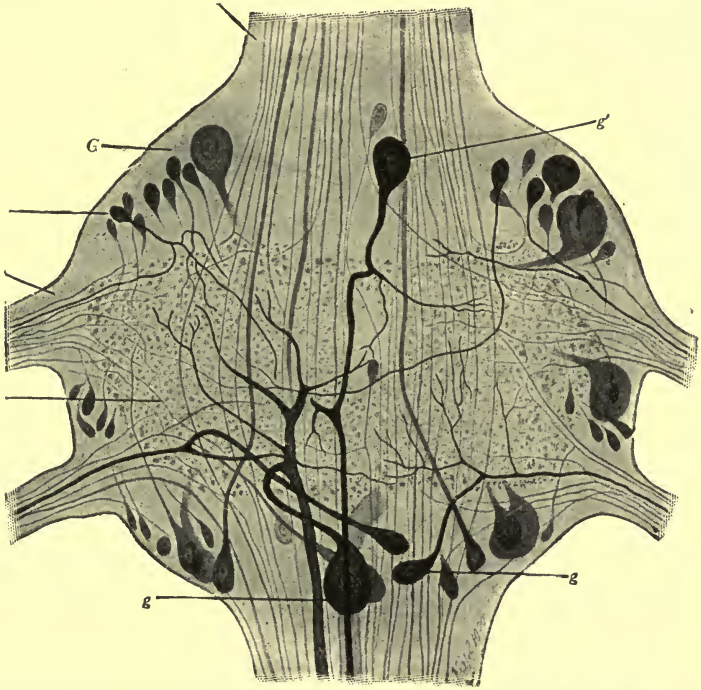

FIG. 8.—Third abdominal ganglion of cray-fish. (*Kingsley's Hertwig After Retzins.*) (Courtesy Henry Holt Co.) G, g, g; ganglion cells and axones.

teristic of which exists in the form of the chorda dorsalis. An important point of distinction between the ganglionic and the tubular nervous system lies in the difference in arrangement of the groups of nerve cells. In the tubular as well as in the ganglionic type, neural segmentation exists; in the former, the segments are arranged as a series of more or less confluent "centres," composed of complex aggregations of neurons, from which the peripheral nerves arise (Fig. 11).

In the development of the vertebrate nervous system the cerebral and spinal components of the central nervous system are originally formed from the ectoderm. As the result of cell proliferation and by reason of change of position of the ectodermal elements the neural plate is formed, which is later transformed into the neural

groove, and finally becomes a thick-walled tube which contains the **central canal** communicating anteriorly with the cerebral vesicles (Fig. 12). The neural tube is marked transversely by faint constrictions which give rise to segmentation, each segment constituting a **neuromere.** Extending laterally between the neural tube and the remaining superficial ectodermal cells, is a pair of flap-like cellular extensions known as the **neural crests.**

The nerve cells originate from cubical or rounded **germinal cells**

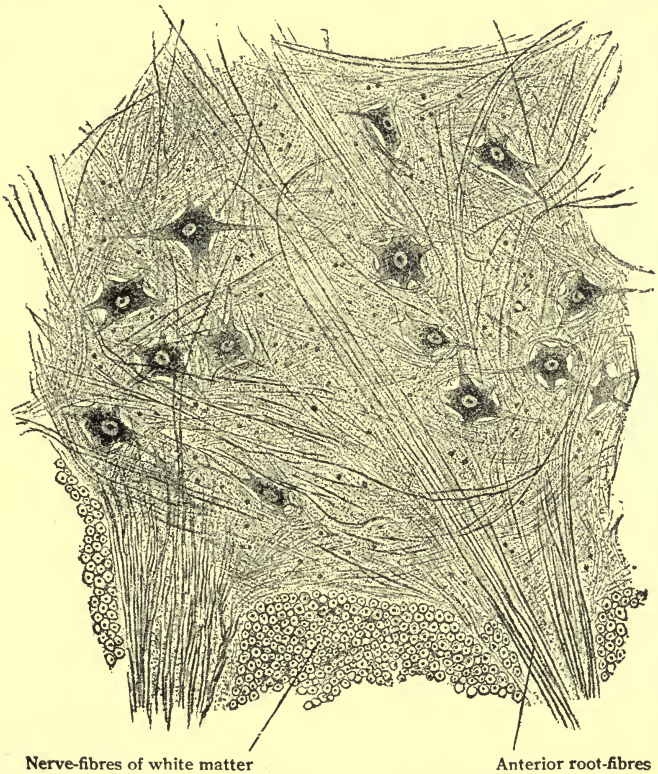

FIG. 9.—Portion of anterior cornu of gray matter, showing multipolar nerve-cells. × 120.

in the epithelial lining of the neural tube known as **neuroblasts.** The nerve cells are located around or near the central canal, but recede from the immediate vicinity of the canal as development advances (Fig. 14).

Some of the nerve cells during the period of growth migrate beyond the limits of the developing spinal cord at its posterior portion, and later give rise to the spinal ganglia. It is from the crests of the neural (Fig. 13) plate that the spinal ganglia and the peripheral nerves develop at points corresponding to the above-mentioned neuromeres. Still other neuroblasts by migration from the

spinal cord and spinal ganglia form the ganglia of the **visceral** (sympathetic) or **autonomic** nervous system.

At the cerebral end of the neural tube the walls become much thicker than in the spinal portion of the tube. The anterior part of the neural tube gives rise to the cerebral masses, and the canal becomes altered in shape to form the corresponding cavities of the

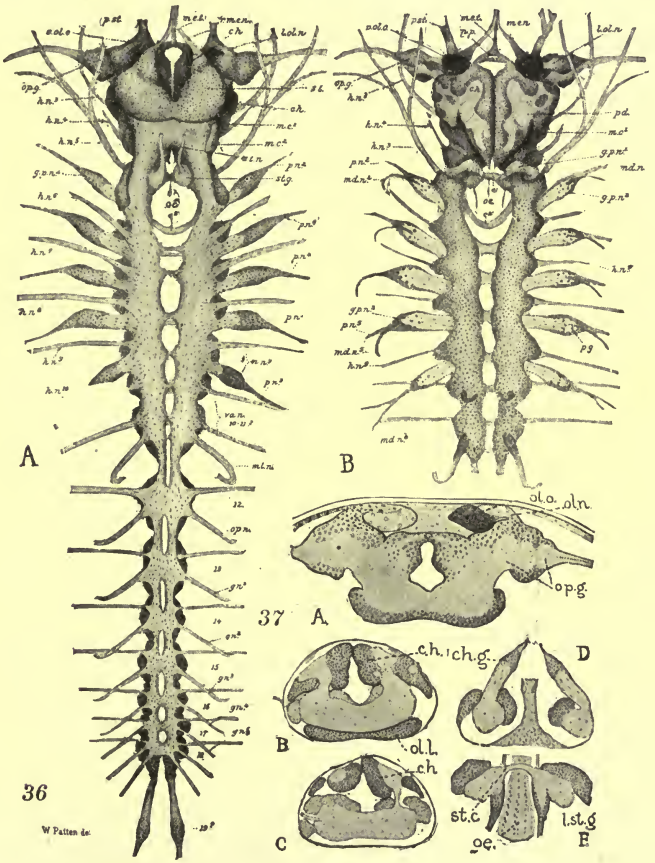

FIG. 10.—Brain and cord of young Limulus (Horse shoe crab). (*Patten's Evolution of Vertebrates, Courtesy P. Blakiston Son & Co.*)

cerebral vesicles, later known as the cerebral ventricles (Fig. 15). Migration of certain nerve cells takes place from the cerebral portion of the neural tube to form the neurons of the olfactory, optic and auditory apparatus, and also for the visceral ganglia in the head.

The nerve fibres originate as prolongations from the nerve cells (Fig. 16). The fibres later acquire their myeline sheaths, and collectively constitute the "white matter." The nerve fibres in the spinal cord lie for the most part external to the nerve cell region. The

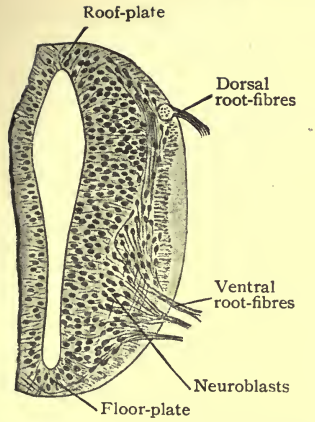

FIG. 11.—Developing spinal cord of about four weeks. × 100. (*Piersol from His.*)

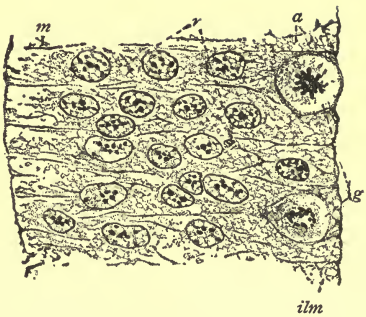

FIG. 13.—Segment from lateral wall of neural tube of pig embryo 5 mm. (*Piersol from Hardesty.*)

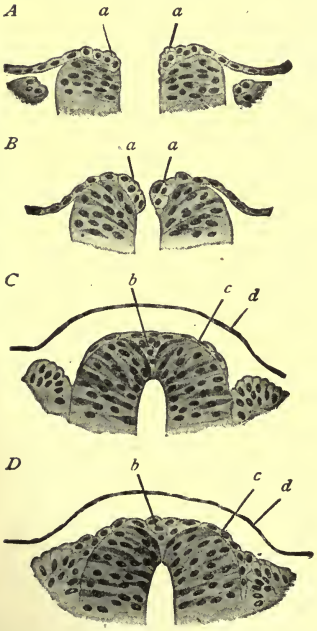

FIG. 12.—Transverse sections of dorsal region of human embryos, showing early differentiation of spinal ganglion; *A*, *B*, neural tube still open; *C*, *D*, tube closed; *a*, ganglion-ridges; *b*, fused ridges; *c*, outgrowth to form ganglion; *d*, ectoblast. × 230. (*Piersol from Lenhossék.*)

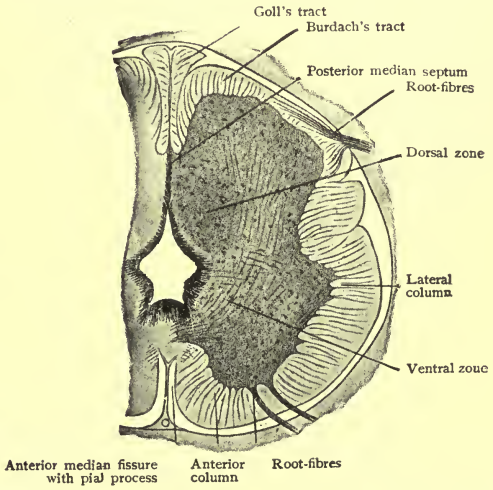

FIG. 14.—Developing spinal cord of about three months. × 30. (*Piersol from His.*)

motor nerve fibres arise from the large ventral ganglion cells which send their axones to the muscles (Fig. 17). The sensory fibres arise in the spinal ganglion cells from which the fibres grow in two direc-

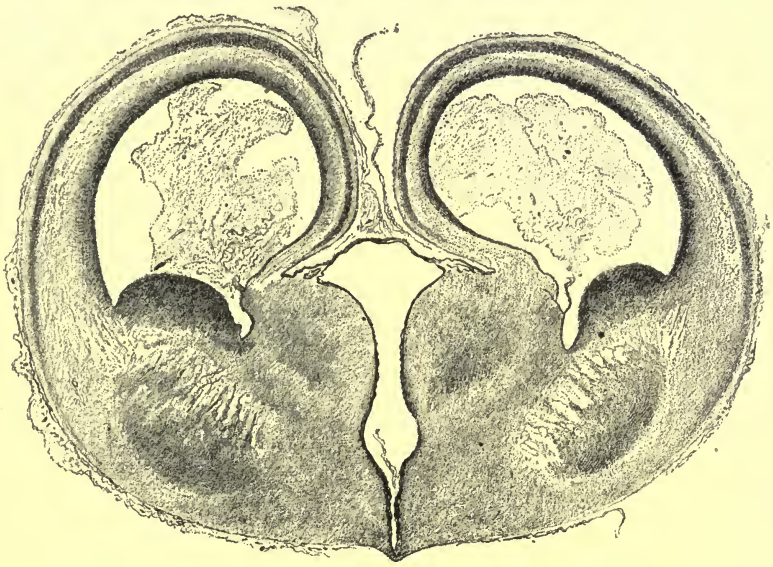

FIG. 15.—Coronal section human embryo brain (drawn from author's preparation). Showing developing cortex, basal ganglia, lateral ventricles, third ventricle, choroid plexuses. Magnified approximately 8 diameters.

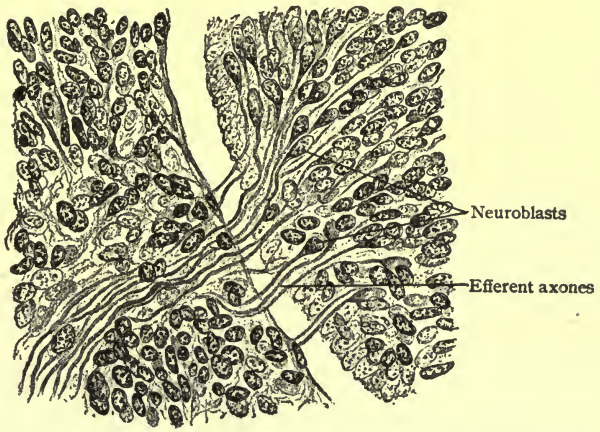

FIG. 16.—Portion of spinal cord of human embryo, showing development of neural root-axones as outgrowths from neural neuroblasts. × 300. (*Piersol from His.*)

tions; one set of fibres leads to the periphery and the other set passes into the spinal cord and thence cerebralwards. In the anterior and lateral portions of the white matter are contained tracts of fibres which originate in the axones located at the cerebral end of the neural apparatus. (See Cerebral Development, Chapter III.)

In addition to nerve cells and nerve fibres there is a third structural element which is peculiar to vertebrates. This is the supporting

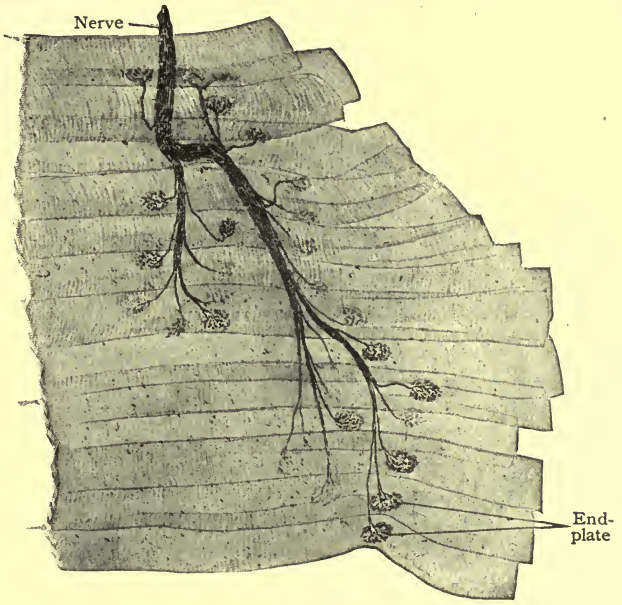

FIG. 17.—Motor nerve-endings in voluntary muscle; bundle of nerve-fibres is seen separating to supply the individual muscle-fibres. × 160. (*Piersol.*)

tissue of the central nervous system—the neuroglia (Fig. 18). Histogenetically the neuroglia arises by dividing cells which are derived from the *spongioblasts* differentiated from the original epithelial lining of the neural tube. Neuroglia consists of cells possessing many finely branching processes which collectively constitute a network of fibres which pervades the entire central nervous system. By virtue of its proliferative function the neuroglia also serves to fill the empty spaces left by degenerated nerve elements which have been destroyed by pathological processes.

FIG. 18.—Young neuroglia cells; astrocytes, from brain of child. × 300. (*Piersol*).

In the higher development of the tubular nervous system as found in mammals and in man in whom the developmental process has reached the highest type, sensory organs are found to have attained their greatest importance. The lower (phylogenetically) reflex functions of the simpler types of nervous systems are not only continued

in the higher animals, but the same functions are also further elaborated in order to meet more complex adjustments. "The finer the differences between external forces which an organism is able to appreciate, the better equipped is it to make use of or to defend itself against those forces." [9]

Sense organs serve the purpose of supplying the organism with unitary nervous functional components, namely, the effects of stimuli which may give rise to immediate reactions, and may also serve as the basis of subsequent reactions. Neural activities may be utilized reflexly by the individual at the moment of receiving the excitation, or they may be reserved for use under the direction of consciousness as occurs in higher organizations.

Development of Structure and Function.—If the life history of an organism is carefully followed, it will be found that vital characteristics

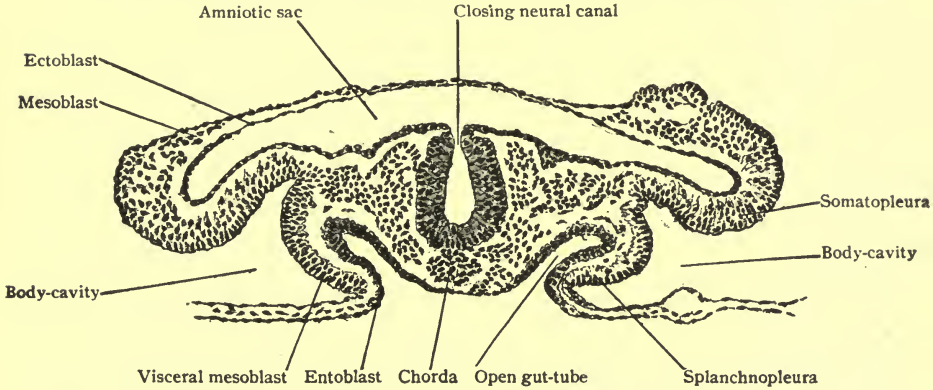

FIG. 19.—Transverse section of rabbit embryo of about nine and one-quarter days. × 80. Neural canal is just closing. (*Piersol.*)

already present in the germ become further elaborated, and that the development of new structures is correlated with the development of new functions. Furthermore, structural changes wrought in the organism by the effects of environment are accompanied by parallel functional modifications, for the reason that structure and function "are merely different aspects of the same organization."

The development of the nervous system, which is "the medium for the propagation of a state of excitation," [10] and its functions seem especially to harmonize with this doctrine. Furthermore, it is very clear that the nervous apparatus should have as its developmental foundation the ectoderm—the structure which comes directly in contact with the environment and is directly influenced by external changes.

In the lower forms of animals (hydroids, corals, medusæ, and star-fish), nerve elements occupy a permanent position in the external body covering. In higher animal forms, as previously stated, the deeper position of the nerve cells is acquired by migration or invagination of those elements from the ectoderm, as is typically represented in the formation of the neural tube of vertebrates (Fig. 19).

Correlation of Nervous and Non-nervous Phenomena.—The phenomena already designated by the term "reaction" may be considered further in the light of physiologic activity in general, with the object of obtaining additional evidence of the fundamental character of that property of organisms termed "irritability."

One may recall from experience the fact that touch and taste stimuli give rise to a reaction accompanied by secretion of saliva, as normally occurs when food is placed in the mouth. During mastication, on account of the added motor functional element, secretion becomes still more active, and in a measure may be initiated at will. Furthermore, the secretion of saliva may be induced by pure mental stimuli, as when one thinks of certain kinds of taste impressions, especially acids.

According to Pawlow,[11] the initiating stimulus for gastric secretion is mental. When food is introduced into the stomach of a dog through a fistula, without attracting the attention of the animal, no gastric juice is secreted and the food is not digested. The same articles of food eaten by the animal are digested promptly as in the normal animal. In the second instance secretory activity was induced by the psychic stimulation of the gastric glands initiated by the necessary visual, olfactory and gustatory sensations. It has been shown that no particular disturbance of gastric digestion follows complete severing of the connections of the nerve supply of the stomach from either the central nervous system or the semilunar ganglion.[12] This observation leads to the conclusion that although nervous influences are important for the activity of digestive function these are not to be considered the only factors. It has been demonstrated that special substances, termed "secretins," which may be obtained from the cells of the mucous membrane of the stomach, stimulate the gastric glands when injected into the blood of the animal. Peristaltic movements of the intestines may be stimulated also by the presence of the food material contained in the tube, or may be brought about by chemical stimulation. All of these chemical and motor phenomena, whether they involve a direct or only an indirect action on the part of the nervous mechanism, are under the control of the so-called "lower centres," and are not within the realm of volition.

The nerve plexuses of Meissner and Auerbach in the submucous and muscular coats of the alimentary canal are regarded as local nerve centres, capable of carrying out coördinated acts in response to stimuli, independently of the central nervous system[13] (Fig. 20).

The results of such observation and experiment seem invariably to strengthen the conclusion that the ultimate function of the nervous apparatus serves to bring about the adaptation of the animal's activities to the conditions under which it lives. This adaptation is reached through experience by contact with environment, either directly or indirectly. and only those animals in which adaptation has been success-

fully accomplished are able to survive the effects of external agencies. Animals with the more complex structural organization are able to adapt themselves to more complex and variable environments.

The Functional Divisions of Nervous Apparatus.[14]—The activities of any individual possessing a complex nervous system may be classed in two groups of phenomena: (1) the immediate effects of external influences upon the nervous system, which give rise to purely nervous reactions, (2) the effect of pure nervous reactions upon non-nervous structures—muscles, bones and other structures, which in turn results in reactions affecting the individual as a whole.

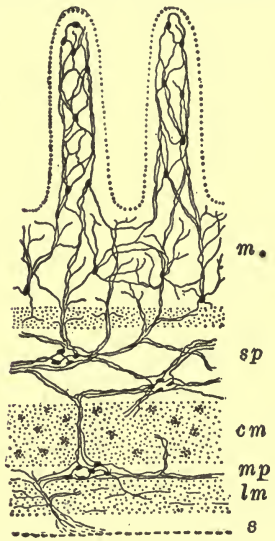

FIG. 20.—Diagram of the nervous organization in the intestinal wall of a vertebrate (after Lewis, 1910); *m*, mucous layer; *s p*, submucous plexus; *c m*, circular muscle; *m p*, myenteric plexus; *l m*, longitudinal muscle; *s*, serous layer. (*Parker.*)

These activities are both internal and external; the external are somatic, arising through the **somatic afferent division** of the nervous system through which the animal receives stimuli from the external world, by means of the sensory organs, especially the skin and visual apparatus. Reactions are accomplished through the **somatic efferent** division of the nervous system which controls the somatic movements of muscles, bones and other skeletal structures.

The internal reactions, as already stated, are the result of chemical changes which do not affect the somatic organs. Chemically stimulated reactions are likewise reflex and concern the organs of digestion, circulation and reproduction. The stimuli for these reactions are received through the **visceral afferent** division of the nervous system. An exception is thus furnished in the reception of such external stimuli as those of taste and smell; on account of their close visceral relation, these are carried by the afferent visceral division.

The **efferent visceral** division governs the non-striated muscles of the viscera, blood-vessels, glandular system and the heart muscle, and corresponds to the sympathetic nervous system in man.

It may be concluded that for the adaptation of any animal the following nervous activities are required: (1) the reception of somatic stimuli, (2) the direction of somatic movements, (3) the reception of visceral stimuli, (4) the directing of visceral activity[14] (see autonomic nervous system, page 63).

Receptors, Conductors and Effectors.—The more or less complex organs located at the periphery of nerves of special sense, and commonly known as " sense organs," are structures which are necessary for those functions which furnish the individual with information con-

cerning the external world, and whose products of activity in their totality imply the existence of states of consciousness. These receptive organs constitute the structural provisions for the reception of external energy applied to the body of the organism, and furnish the only means by which impulses may gain entrance to the peripheral nerve pathways in order to reach the central nervous system, and by which reactions to stimuli can be initiated and adjustments to environmental influences may be made by the organism.

Inasmuch as the use of the terms " sense organs " and " sensations " is regarded as properly employed only in referring to the nervous functions in animals known to experience states of consciousness, it is necessary, for descriptive purposes, that appropriate terms be available which can properly be used to describe nervous reactions in general. Those structures which have become differentiated for the reception of stimuli are termed " receptors," and are so " constituted in adaptation to the stimuli delivered by environmental agencies " (Sherrington). These receptor cells and organs which are developed from the epiderm are connected directly or indirectly with the outer body layer, and therefore are constantly exposed to environmental changes and ever ready for the reception of stimuli produced by the effects of external agencies.

Receptors are the mechanism by which various minute forces acting upon the organism seem to be magnified in order that they may set up a commotion of one kind or another in the nervous apparatus.

The tissues of the body covering are not alone concerned in the receptive function. As a result of the activities of the organism as a whole there are changes which take place within the soma, especially in the osseous and muscular systems which supply stimuli for other receptors.

The two classes of receptors are designated according to the origin of the stimuli received by them, thus:

(1) The receptors receiving stimuli from the external world are termed **extero-ceptive**, and the source of the stimuli is designated the extero-ceptive field.

(2) The receptors which receive their stimuli as the result of the activity of some organ (intero-ceptor), *e.g.*, muscular contractility, are termed **proprio-ceptive** receptors, and their source is known as the proprio-ceptive field. These receptors are related to external agencies only indirectly.

Among the cells differentiated for neural functions some are adapted for the transference of the effects of stimuli received by receptor cells, and are accordingly named " conductors." In higher animals the conductors are directly connected with nerve fibres leading peripherally to the receptors, and also are connected with other nerve cells in the central nervous organ.

A third structure, which closes the functional chain, is the muscle,

gland or other organ, which may be stimulated to a state of activity This is known as an "**effector,**" also connected with a nerve cell and the conductor, and therefore is connected indirectly with the receptors. The simplest nervous mechanism may be said to consist of three differentiated parts—*receptive, conductive* and *effective* (see Fig. 2).

Conditioned Reflexes.—Among the attempts to investigate the nervous mechanisms accompanying the functional activity of the " higher " cortical centres generally supposed to preside over the psychical activities, the more recent methods of Pawlow, known as that of " conditioned reflexes," have opened a new field for the study of the functions of the central nervous system. Pawlow's method of approach makes no attempt to study directly the mental states concerned in the production of consciousness. In fact, he is inclined to regard the introduction of psychological modes of expression as a hindrance rather than an aid to the solution of the problem.

For the purpose of elucidation of the matter of conditioned reflexes, it should be borne in mind that the simpler reflexes, such as coughing and sneezing, are responses of a definite character, arising when a stimulus is applied to an appropriate receptor and is carried thence to the sensory limb of the reflex arc and to the corresponding nerve centre.

In contradistinction to this definite and invariable character of response from the lower centres, the higher centres, that is, those of the cerebral cortex, are capable of producing reactions which show a wide variation in character under varying conditions with the application of the same kind of stimulus, or there may occur no reaction at all, as the result of inhibition. It is in this sense that the simpler or lower reflexes are unconditioned and the higher reflexes are conditioned.

In the higher centres no such invariability as to kind of response which follows a given stimulus exists. On the contrary, the reaction which follows stimulation of such a centre depends upon several factors or conditions which are the effect of various temporary combinations or associations of centres. It is the temporary nature of the associations between centres involved in the reaction which accounts for the application of the term " conditioned reflexes."

Pawlow regards a conditioned reflex as " a reaction to an indifferent stimulus, occasioned by the repetition of the latter with a physiologically active stimulus." Thus, if a sound be produced at the same time that the mucous membrane of the mouth is irritated by an acid, if repeated several times, it soon follows that the sound produces the same effect as the acid stimulation, namely, a flow of saliva. In other words, the sound becomes the stimulus for salivary secretion.

Pawlow regards the temporary combinations as produced by the new and non-essential or indifferent external stimuli, such as the ringing of a bell or the beating of a metronome, which are repeatedly presented to the organism at the same time as the stimulus which normally

produces the reflex when it is acting alone; for example, the stimulation of the mouth cavity by the presence of food or an acid.

The presentation of the newer, formerly indifferent stimulus, may subsequently excite the production of the reflex. The secretion of saliva is normally excited when an animal is given food. This is an unconditioned reflex, inasmuch as it is bound to occur whenever the appropriate receptors are stimulated by the presence of food in the mouth. If, when food is given to the animal (Pawlow experimented with dogs), a bell is rung every time, it will be found that, after this has been repeated a number of times, the ringing of the bell alone will be sufficient to stimulate salivary secretion and constitutes a **conditioned reflex.**

The results of Pawlow's experiments have been published chiefly in the Russian language and are therefore not available to the majority except through abstracts and translations. Morgulis [15] has reviewed the subject and presented the substance of Pawlow's theory in available form.

The abstract states that Pawlow regards the nervous system as a duplex mechanism consisting of a receptive and an executive part, but also possessing an intermediary portion which is of the greatest functional importance. The reflex arc begins in: (1) a sensory brain cell situated at the terminal part of any afferent nerve; (2) an interlinking piece between this, and (3) the executive or effective part of the reflex arc—*e.g.,* muscle or gland; Pawlow holds that psychic activity is "a complex nervous function which is fulfilled by two mechanisms identified with the first two portions of the reflex arc. One seems to break up the complexity of the outside factors into their ultimate elements; the other seems to bring the various agents of the outside world into temporary association with fundamental organic functions."

One is the "analyzer"—receptor and cortical cell; the other is the mechanism of conditioned reflexes. Pawlow holds that the mechanisms of conditioned reflexes have no specialized centre in the cortex, as the "association centres," but comprise the hemispheres as a whole. "The hemisphere is the seat of the conditioned reflexes, just as the spinal cord is the seat of the unconditioned reflexes."

Formation of Conditioned Reflexes.—An external stimulus acting upon an analyzer (sensory ending, sensory pathway and sensory centre) may be brought into temporary association with a physiological action, such as that of the salivary gland, if that stimulus be combined with the natural or physiological stimulus of the gland (food, acid). When the connection or association by which the conditioned reflex is established is first formed, any stimulus from the same receptive surface or organ acts as a conditioned stimulus of the gland.

It has already been pointed out (page 19) that the sight of food or even the thought (idea) of food may stimulate the flow of saliva. On the other hand, certain emotional states, such as fear, may

inhibit the flow of saliva, as when the "tongue cleaves to the roof of the mouth." In such instances the higher centres acting as receptors are brought into temporary association with a reflex function, in the same way that the normal receptors, for example, those of the mucosa of the upper part of the digestive tract, are ordinarily essential for the production of the reflex act.

The formation of conditioned reflexes presents two phases which form the bases of two laws:

1. The *law of radiation* of nervous processes in the cortex; that is, every stimulus reaching a definite nerve cell diffuses itself over the entire centre (sensory). The stronger the stimulus the wider becomes the area of diffusion.

2. The *law of concentration* of nervous processes; that is, by continued repetition, the diffuse auditory stimulus becomes so differentiated and concentrated that the stimulation produced by, for example, 1012 vibrations can be differentiated from 1000, or 94 beats of the metronome as distinct from 100. This concentration with the differentiation of the stimulus is due to the development of an *inhibitory* process which arises within the analyzer.

According to Pawlow, psychic activity "is nothing but an endless chain of reflexes, that is, determined responses to environment."[15]

If food is given to a dog through a stomach tube at the same time that painful stimuli are applied to some part of the body, such as would call forth a defensive reaction, the defensive reaction may subside and the stimulus which was formerly painful becomes a conditioned reflex of the salivary gland.

On the same basis may be explained the apparent insensitivity of persons to painful experiences and sometimes even to fatal injuries received during periods in which there is marked nervous activity, such as accompanies extremely dangerous situations. The function of the higher centres is controlled by the flow of nervous energy towards the seats of highest irritation rather than towards the lower centres. It is stated that no region of the cortex has been assigned to pain experiences (Sherrington).

Pawlow regards consciousness and unconsciousness as purely physiological phenomena of the same order; a state of the cerebrum characterized by an optimum affectability. The conditioned reflexes which have been established at some earlier period become active at the moment. There is a constant changing of the degree of reactivity throughout the various regions of the cerebrum; one being the dominant at one moment, and at another moment another supersedes the activity of the higher functions.

Heredity

The development of an organism depends fundamentally upon cell differentiation. By this means, as a result of the elaboration of struc-

tures already possessed by the united egg and sperm cells, particular structures and functions are developed in the completed animal. The germ cells are complex structures in themselves and possess characteristics peculiar to their organization, upon which fact depends the appearance of specific characteristics in the offspring. It is this, the most important factor in the process of reproduction and the continuation of a species, which is called *heredity*.

In ordinary parlance, the term heredity is usually interpreted to mean that parents transmit certain characteristics to their offspring. It will be shown that this statement is not accurate, if it be taken into account that in multicellular animals the parent organisms are composed of many cellular constituents, the majority of which have no direct part in the reproductive functions. *The only structures directly concerned in the reproduction of the individual's kind are the germ cells (oösperm).*

It is generally accepted that the term heredity means that property of an organism by which its peculiar nature is transmitted to its descendants, according to Weissman.[16] In a dynamic sense heredity has been defined, according to Conklin, as "the organization of the germ and all that depends upon it."

Of the earlier students of the problem of development, there were two schools: the first were the evolutionists or preformationists who virtually denied the existence of a developmental process, but considered that all parts of the future animal were contained in the germ and that growth was all that was necessary. The other school, composed of epigenesists, regarded the germ as a homogeneous mass which required some external force, the nature of which they did not attempt to explain, to cause the germ to become heterogeneous.

Both of these extreme views are now held to be incorrect; if there is any inclination towards either, it may be said to be towards the preformation idea, as is shown in Weissman's theory of determinants. This theory assumes that an organism is a complex of characteristics, and the chromatin mass in the nucleus of the cell (Fig. 21) is regarded as possessing a corresponding number of particles, or hypothetical units, the **determinants,** or forerunners, of the characteristics of the organism. Each independently variable characteristic of the progenitor, whether it be paternal or maternal, according to this hypothesis, is considered as having its corresponding determinant which *may* appear in the offspring.

From the theory of determinants it would follow that an egg cell, fertilized in the usual way, becomes the possessor of two kinds of determinants, that is, it possesses *duplex characteristics,* of both male and female origin. The characteristics which are to appear in the offspring will be determined by the activity of the determinants. The characteristic that appears to the exclusion of any other characteristic and is "transmitted entire" is said to be *dominant,* and the characteristic possessed by the parent, but which does not appear in the offspring and is latent, is said to be *recessive.*

The process of development of an organism (multicellular) consists primarily of cell multiplication and cell differentiation, together with differentiation of function, and results in the formation of an adult animal produced by the union of two germ cells.

The Mechanism of Inheritance of Characteristics.—In the process of reproduction certain germinal material contained in ancestral cells is continued and passed on from one generation to another, so that the germ cells of one generation are biologically linked to the next and to succeeding generations. This "continuity" of germ plasm implies that germ cells can only be produced from germ cells, and that body cells, after becoming differentiated from germ or em-

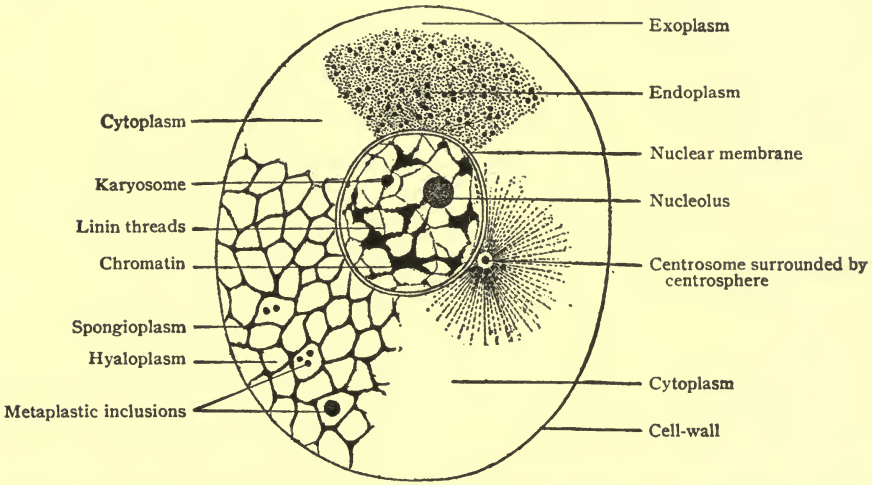

FIG. 21.—Diagram of cell-structure. In the upper part of the figure the granular condition of the cytoplasm is represented; in the lower and left, the reticular condition. (*Piersol.*)

bryonal cells, produce only body cells. From the standpoint of heredity, this point of dissimilarity between the germ cells and the somatic cells is of fundamental importance.

Sex cells are the latest in reaching full development. The developmental period of the ovum and sperm cell includes a period of cell division and a period of growth, which takes place in the ovary or in the tubules of the testis, as the case may be. When the last division of the primitive sex cells (gonia) has taken place by the changes of ordinary mitotic division, the resulting oögonia and spermatogonia are ready for further growth (Fig. 22).

The Chromosomes.—While still in the ovary or tubules of the testis the sex cells continue in the growth process, during which certain changes take place in the nuclear material, but without further cell division. The chromatin skein of the nucleus is loosened and the component threads arrange themselves into pairs of *chromosomes.* The pairs are composed of chromosomes that have visibly

similar characteristics, especially as to shape and size. This pairing of chromosomes is known as the "conjugation process" or "synapsis."

Furthermore, one member of each pair of chromosomes often can be distinguished as having arisen from the mother cell, and the other member of the pair as having come from the father cell, of the previous generation. Although there are instances in which this cannot be

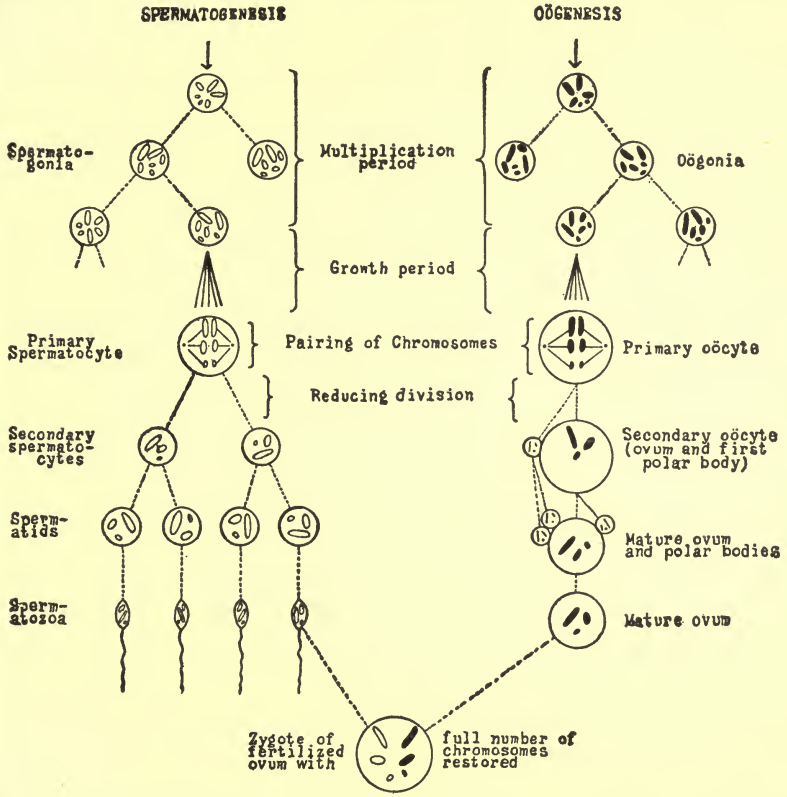

FIG. 22.—Diagram of gametogenesis showing the parallel between maturation of the sperm cell and maturation of the ovum. (*After Guyer. From East and Jones.*)

demonstrated, there is sufficient reason for believing that it always occurs (Conklin).

The chromatin substance which is present in equal quantities in both ovum and sperm is regarded as the seat of inheritance material; "Each maternal chromosome mates with a paternal chromosome of the same kind."[17]

If, in the union of the sex cells, the total number of chromosomes of the male element were added to those of the female, there would clearly result a doubling of the number of chromosomes, and also the number of determinants would be doubled with each successive gen-

eration. This, of course, does not occur, being obviated by a provision in the form of a series of changes in the chromatin substance, constituting the process known as **maturation.**

Maturation is essentially a reduction of the number of chromosomes so that each mature sex cell when ready to be fertilized will contain only one-half the number of chromosomes possessed by the immature sex cell. The changes which take place in the maturation process are similar to those of ordinary mitotic cell division. At the beginning of this process the germ cell presents the appearance of the

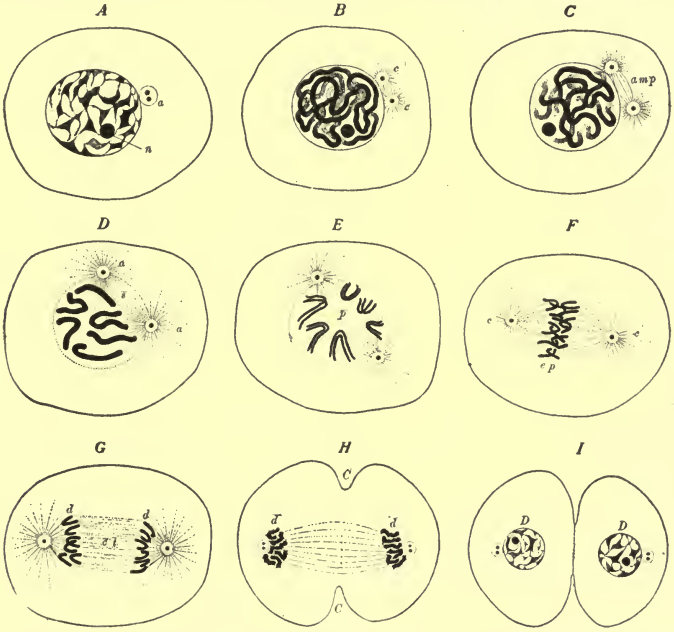

FIG. 23.—Diagram of mitosis. *A*, resting stage, chromatin irregularly distributed in nuclear reticulum; *a*, centrosphere containing double centrosome; *n*, nucleolus. *B*, chromatin arranged as close spirem; *c*, *c*, centrosomes surrounded by achromatic radial striations. *C*, stage of loose spirem, achromatic figure forming amphiaster (*amp*). *D*, chromatin broken into chromosomes; nucleolus has disappeared, nuclear membrane fading; amphiaster consists of two asters (*a*, *a*) surrounding the separating centrosomes, connected by the spindle (*s*). *E*, longitudinal cleavage of the chromosomes which are arranged around the polar field (*p*) occupied by the spindle. *F*, migration of chromatic segments towards new nuclei, as established by centrosomes (*c*, *c*); *e p*, equatorial plate formed by intermingling segments. *G*, separating groups of daughter chromosomes (*d*, *d*) united by connecting threads (*c t*). *H*, daughter chromosomes (*d*, *d*) becoming arranged around daughter centrosomes which have already divided; *C*, *C*, beginning cleavage of cytoplasm across plane of equatorial spindle. *I*, completed daughter nuclei (*D*, *D*); cytoplasm almost divided into two new cells. (*Modified from Wilson.*)

" resting nucleus " stage of ordinary mitotic division. About the time of the formation of the achromatic spindle, the centrosome divides into two daughter centrosomes which move to opposite poles of the cell at the extremes of the spindle. The nuclear membrane disappears and the chromatin arranges itself in the form of a collection of threads, the **chromosomes,** the number of which is fixed for each animal species. The chromosomes arrange themselves in the plane of the equator of the cell between the daughter centrosomes (Fig. 23).

The division of the egg cell presents in this phase of the maturation process an important variation from the usual cell division. Instead of an equal division of the cytosome, as occurs in the formation of daughter cells generally, the division takes place very unequally; the resulting cells are: (1) a very minute cell—the first polar body, and (2) a much larger cell—**the ovum.** The ovum now undergoes a second unequal division, giving rise to the second polar body (Fig. 22). In one of these divisions each chromosome of the pair separates from its mate following the line of conjugation and separates into two parts. The chromosomes migrate towards the poles of the cell, half the number towards one centrosome, and half towards the other, and at nearly the same time there is a division of the cell body (cytosome) into two parts, constituting two daughter cells, each of which contains half the original number of chromosomes. The ovum now has only one-half the number of chromosomes characteristic of the species and possesses practically all of its original cytoplasm, but has lost one-half of its chromosomes and the centrosome; these have passed out at either the first or second maturation division.

The male element, the spermatozoön, also undergoes a similar maturation process in the tubules of the testis. The number of chromosomes is reduced in a manner similar to that in the maturation of the egg-cell. The difference, however, lies in the fact that instead of one of the four daughter cells becoming capable of sexual union, as is the case with the ovum, there are four mature spermatic elements (spermatozoa) resulting from the division, each one potentially capable of fertilization (Fig. 22).

The essential feature of the spermatic maturation is the same as that of the egg cell, namely, the reduction of the chromosomes to half the original number. In the maturation of the egg-cell the centrosome is lost, thus rendering that cell incomplete and incapable of developing (Hertwig). The spermatozoön is also deprived of one of the essentials for development; it lacks the necessary food material—the cytoplasm. The centrosome is carried in the middle-piece or body.

Before the maturation process, both the egg-cell and the sperm-cell carry in the chromatin certain elements or factors (the "determinants" of Weissman) which have been derived from the progenitors of those germs-cells; therefore, each egg-cell and each sperm-cell possesses both maternal and paternal material represented in the chromatin.

The chromosomes, therefore, are considered as representing those maternal and paternal characteristics. Some of these factors during the maturation process have been eliminated; in the case of the ovum either maternal or paternal chromosomes may be eliminated in the formation of the first or second polar bodies.

The mature egg-cell, containing half the original number of chromosomes, may contain either maternal, paternal, or both kinds of chromosomes, inasmuch as the elimination of individual chromosomes

is a matter of chance. "But since the position of pairs of chromosomes in the spindle is a matter of chance, it rarely happens that all the paternal chromosomes go to one pole and all the maternal chromosomes to the other pole." [18]

Similar changes with respect to the chromosome arrangement occur in the sperm-cell, with the exception, already stated, that four sper-

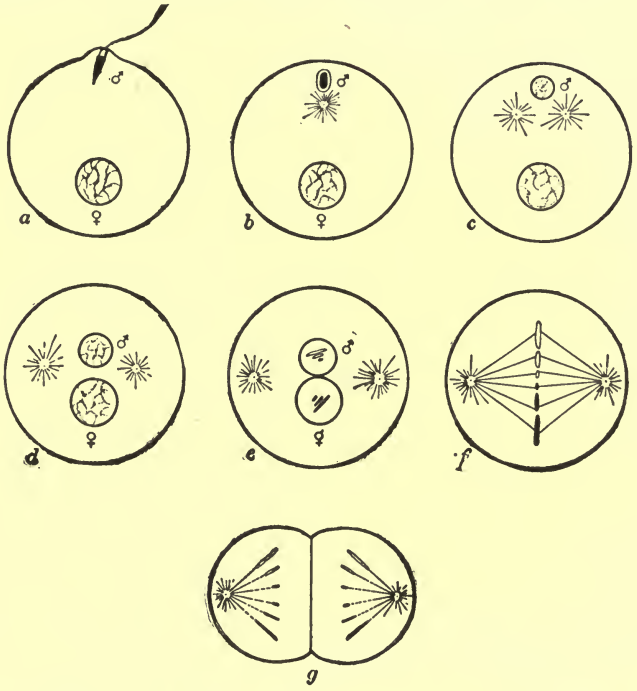

FIG. 24.—Diagram to illustrate fertilization; ♂, male pronucleus; ♀, female pronucleus; observe that the chromosomes of maternal and paternal origin, respectively, do not fuse. (*After Guyer.*)

matocytes are formed, each one of which is potentially capable of carrying either its maternal or its paternal chromosomes, or both.

The moment that the sperm-cell touches the surface of the mature ovum, the latter throws out a point of protoplasm for the reception of the sperm-cell, which finally penetrates the cytosome of the egg. This phenomenon with the changes which follow is known as the **fertilization process,** which usually takes place at the time of the formation of the polar bodies (Fig. 24).

The now fertilized egg-cell (oösperm) contains both male and female chromosomes; the original number of chromosomes has been thus restored. The question of the inheritance of paternal or maternal characteristics in the offspring will depend upon *the kind of elements (chromosomes) retained by the egg-cell during maturation, and upon the kind of elements introduced by the sperm-cell.* Fertilization—the

union of the egg and sperm—controls inheritance only in so far as the process brings about a mixing of the elements carried by the mature sex-cells. If it happens that in the maturation process the chromosomes (determinants) representing a given characteristic have been eliminated, the offspring cannot gain the factors which tend to produce that characteristic.

On the other hand, if the matured germ-cells carry the determinants which produce a given characteristic, the offspring are *likely* to possess that characteristic.

The reason for assuming that the chromosomes are important factors in heredity and differentiation is summarized by Conklin as follows: "(1) They come in approximately equal numbers from the father and the mother, (2) one-half of each of the maternal and paternal chromosomes is distributed to each cell of the developing organism, (3) in the formation of the egg- and the sperm-cells the normal number of chromosomes is reduced by one-half, and (4) in the fertilization process the normal number is restored by the union of the egg and the sperm." [18]

Furthermore, although the determiners which make for certain inherited characteristics do become united in an individual, they frequently become isolated or "segregated" in subsequently formed germ-cells of that individual. As the result of this kind of inheritance, which is known as Mendelian inheritance, certain characteristics not only are transmitted from parent to offspring, but they also tend to recur with a certain degree of regularity in subsequent generations, to the apparent exclusion of some of the characteristics possessed by the parents.

The important facts concerning the mechanism of inheritance may be summarized as follows:

(1) The germ-cells are the only structures directly concerned in the transmission of characters from parents to offspring.

(2) The inheritance material is contained in the chromosomes of the germ-cells.

(3) The body of the parent is merely the protector and carrier of the germ-plasm, "the mortal trustee of an immortal substance."

(4) The chromosomes come in equal numbers from the male and female parent germ-cells.

(5) The phenomenon of fertilization serves in the mechanism of inheritance to bring about a mixture of the chromosomes of the mature sex-cells from two separate individuals.

(6) Characters present in the parent may or may not be represented in the germ-cells, depending upon the elimination or retention of the corresponding determinants during the maturation process.

Galton's Law of Inheritance.—Among the earlier studies of inheritance, those of Francis Galton were the most important from the scientific standpoint. These studies were concerned with researches

based upon observations of several families from the standpoint of particular characteristics, such as stature, color of eyes, mental and physical disease and mental traits. The results of these observations Galton expressed in statistical formulæ, and the conclusions reached were stated in terms of two fundamental principles. The first is the Law of Ancestral Inheritance which regards the child as deriving one-half of its total heritage from its two parents, one-quarter from its four grandparents, and one-eighth from its eight great-grandparents, and so forth. According to this law the contribution of each ancestor diminishes directly with the remoteness of the ancestor. The second principle deduced by Galton is known as the Law of Filial Regression, which states that the offspring tend to reach an average of the general population of the race, whether or not the parents may be above the average in stature or in mental qualities. This second principle is, therefore, discouraging to the hopes of a gifted parent, that his offspring will be equally gifted, for "the more bountifully a parent is gifted by Nature, the more rare will be his good fortune if he begets a son who is as gifted as himself."[19] The statistical method of the study of inheritance has been followed by other investigators, especially by Pearson, who has modified somewhat the figures of Galton, shown in the conclusion that the parents contribute one-half to the total heritage, as indicated in Galton's figures, but that the grandparents are credited with one-third, and the great-grandparents two-ninths of the total heritage.

The statistical method of the study of inheritance has been criticized upon the basis of the fact that while the results are important in their application to characteristics of the general population, they cannot be applied to individuals, because in the statistical method individual characteristics are not taken into consideration, but rather those of a group of individuals. As the doctrine of Mendel indicates, certain ancestors may contribute nothing from the standpoint of some characteristics. The physiologic laws which are largely responsible for the cause of heredity are omitted from the statistical method, which is accordingly considered biologically of less value in the determination of the operative factors in the control of inheritance. Furthermore, the statistical study of the problem appears to disregard the distinction between inherited characteristics and those which are the result of the influence of environment, which distinction is essential to any study of heredity. Galton's method is credited with having its chief importance in the fact that "it helped to outline the problem but did little to solve it" (Conklin).

The Mendelian Laws of Heredity.—For the present status of the problem of heredity biology is indebted to Gregor Johann Mendel, Abbot of Brünn, Austria, who published the results of a work extending over several years, under the title of "Experiments in Plant Hybridization," which appeared in 1866. Mendel's experiments were distinctly biological and his observations were concerned with *individual*

organisms and their characteristics. His conclusions, which were of so great biologic importance, were formed before Hertwig observed the phenomena of fertilization. The work of Mendel has received renewed attention since the botanist de Vries and others, in the year 1900, independently discovered the principles laid down in Mendel's publication which was brought into prominence less than two decades ago. The credit of the discovery of these principles has been given to the Austrian monk, and the laws named for him, the "Mendelian Laws."

The studies of Mendel were based upon observations and experiments carried out in the crossing of varieties of the edible pea (*Pisum sativum*). He selected this plant for his purpose on account of the fact that the flowers are capable of self-fertilization and bear a structure which prevents the possibility of a mixed fertilization by the pollen of another variety. To prevent self-fertilization the stamens were removed before the ripening of the pollen, and by artificial fertilization with the pollen of another strongly contrasted variety, allowing the hybrid plants thus produced to fertilize themselves, and by a cross-fertilization of the hybrids, subsequent generations were produced and their characteristics were noted.

The characteristics, which were found to be constant, and at the same time so strongly marked as to serve as striking points of difference by which the varieties could be recognized in the hybrids, were the following:

Length of stem—long or short.
Position of flower—axial or terminal.
Form of seed—round or wrinkled.
Color of seed material—pale yellow or green.
Color of seed coats and flowers—colored or nearly colorless.
Color of cotyledons—green or yellow.
Form of pods—inflated or wrinkled.

Mendel assumed that the total inheritance of the offspring was represented by the male and female germ-cells or "gametes." Each germ-cell is also assumed to carry the factors or causes of one type of characteristics and never factors or causes of contrasted characters.

Pollen from the flower of a tall variety was transferred to the stigma of a dwarfed variety, the stamens having been previously removed. This crossing resulted in producing hybrids in the first generation, which possessed the characteristic of the tall plants. Colored varieties were crossed with white and produced only colored; those with yellow cotyledons crossed with green produced only yellow; smooth-seeded plants crossed with wrinkled produced only smooth.

As previously stated the characters which appear in the hybrid offspring are said to be "dominant"; the characters of the parent which do not appear in the offspring and which are present, but become latent, are said to be "recessive." Thus tallness is dominant to dwarfness; color is dominant to absence of color; yellow albumen is dominant to green albumen; smooth seeds are dominant to wrinkled seeds.

The dominant characters are, for diagrammatic purposes, represented by D, recessive characters by R, pure dominants by DD, pure recessives by RR, impure dominants are indicated by D (R). The successive filial generations are indicated by F1, F2, F3, and the parents from which the crossing starts by P.

The resulting hybrids of the parental crossing were allowed to self fertilize, and it was found that the characters of both parents appeared in the offspring. Thus, the hybrids produced both tall and short plants, but 75 per cent. were tall, and 25 per cent. were dwarfed. This separation of the pure dominant and the pure recessive characters Mendel attributed to the make-up of the male and female sex-cells.

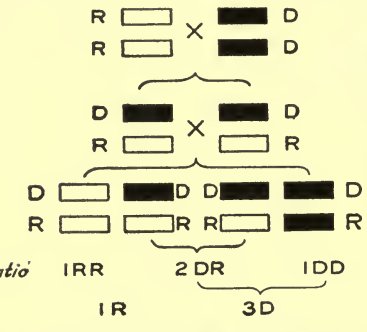

FIG. 25.—Mendel's schema applied for a pair of single contrasted characters; *a*, pure dominant, (*D*) with a pure recessive (*R*) form. (*Bateson.*)

By using the symbols referred to, the result of hybridization is diagrammatically represented by Bateson [20] (Fig. 25). Indicated by symbols alone the results of hybridization may be represented thus (Drinkwater):

D × R
D
D D D R

In this, the first generation (F1) the recessive characteristic is present, but as yet latent. The dominant may therefore be represented by D (R), and the formula changed to read:

D × R
D (R)
D D D R

Two kinds of germ-cells are produced by the hybrids, that is, in D(R) one germ-cell possesses the dominant character of the dominant parent; the other germ-cell contains the recessive character of the recessive parent. The dominant and recessive characters group themselves, or "segregate," in the hybrids in one or the other gamete. No gamete can carry both dominant and recessive characters. A hybrid possesses these two kinds of gametes in equal numbers—part dominant and an equal part recessive. This holds true whether for pollen or ovule.

The gametes of the parents of the first hybrid are of one kind in each parent. As the gametes of one parent are dominant, all the offspring of the first filial generation (F1) possess the dominant character.

The hybrids produce two kinds of gametes; one-half possesses the dominant character of the dominant parent; the other half possesses the properties of the recessive parent; therefore, their offspring will not be of one kind.

The dominant factor of the sperm unites with a dominant factor of the ovule. The recessive factors of the sperm must, therefore, unite with the dominant—recessive factors of the ovule. In each case in which there is a dominant active gamete, there will result a zygote showing the dominant characters, of which there will be three in the above instance, but only one will be pure. The fourth will be a pure recessive; one will be pure dominant. The pure zygotes were termed by Bateson "homozygotes," the mixed or impure zygotes, termed "heterozygotes." because they contained both dominant and recessive characters. They appear as true dominants but are not. The formula again changes to read:

$$\begin{array}{c} D \times R \\ \uparrow \\ \text{DD} \quad \text{D(R)} \quad \text{D(R)} \quad \text{RR} \end{array}$$

DD = zygote of two dominant gametes and is pure—homozygotic.
D(R) = zygote of impure dominant—heterozygotic.
RR = zygote of two recessive gametes and is pure.

The result is that the hybrid really produces one (1) pure dominant, two impure dominants and one pure recessive. Furthermore, the DD breeds true to dominant characters, and the RR breeds true to recessive characters. The impure dominants produce the same that their hybrid parents produce, namely, one pure D, two impure D, and one pure R.[21]

In the experiments made with *Mirabilis jalapa,* the four-o'clock, by crossing the white with the red varieties, the mixed dominants are more clearly distinguished. In the first generation the resulting plants had all pink flowers, but in the second generation there appeared 1 red (pure dominant), 2 pink (mixed dominant) and 1 white (pure recessive) (Fig. 26).

The pure dominants and the pure recessives breed true by self-fertilization, producing pure dominants and pure recessives respectively. The mixed dominants always give rise in succeeding generations to the proportion 1 red: 2 pink: 1 white.

The hybrids which are produced as the result of the crossing of the red and the white varieties carry the factors which produce both white and red, but the individual germ-cells of the hybrid variety carry only the factor for either red or white. The segregation of the factors occurs in such a manner that one-half of all the germ-cells carry the factor for red and the other half the factor for white.

Upon the Mendelian basis was established the doctrine of "unit characters," that is, characters which are entirely inherited and can not be divided further to form other characters.

It is this principle in the Mendelian doctrine which has received much criticism.

The term " unit character " is now used with a considerable amount

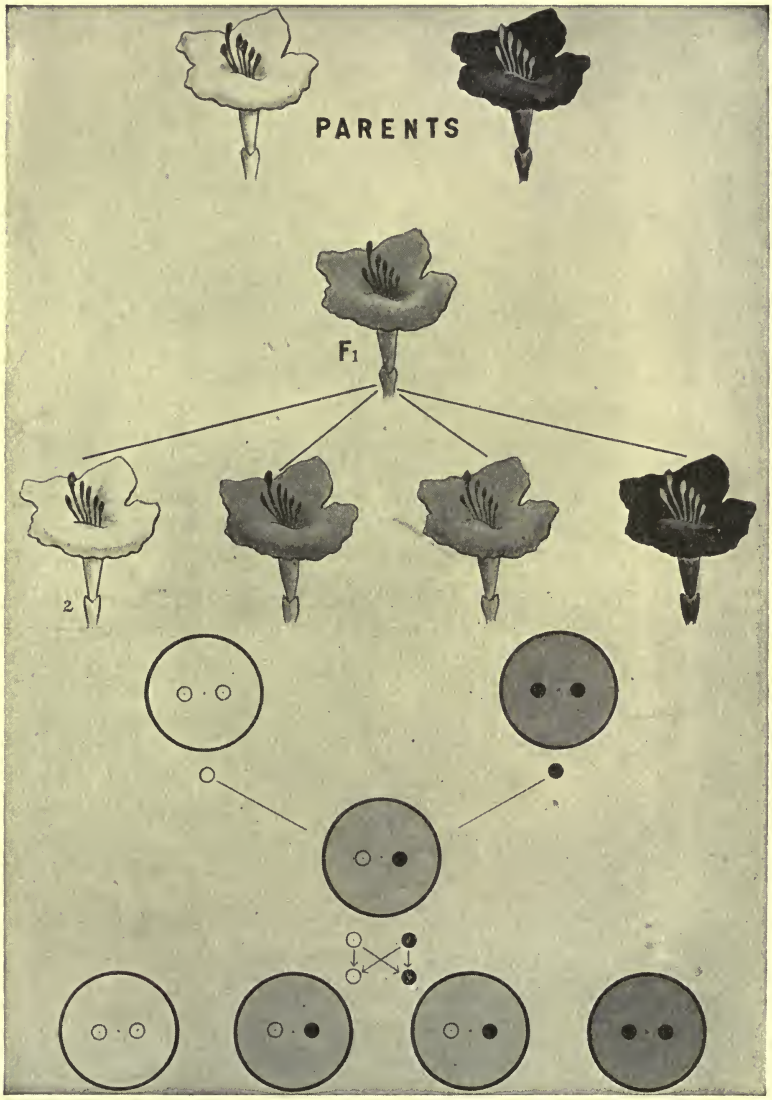

FIG. 26.—Cross between white and red flowered four-o'clocks (*Mirabilis jalapa*). In the lower part of the diagram the large circles represent somatic conditions, the included small circles the genes that are involved. (*Morgan.*)

of reservation. Morgan is inclined to the view that each factor is more likely to affect the entire body than it is to affect only a particular character.[17]

The modified views upon the Mendelian laws hold that none of the characteristics are to be regarded as independent of every other characteristic, and yet for the purpose of study they may, for the time, be considered as such. Every character is probably the result of many causative factors, as in the case of the development of color in which there are necessary a pigment factor and a color developer. In some instances, as in the color of rabbits, as many as eight factors may be concerned, while in plants (snapdragon) as many as twenty factors have been determined as being necessary to produce the color and form.

Since the work of Mendel, it has been shown that the chromosomes of the germ-cells "fulfil all the requirements of the Mendelian factors. Both factors come in equal numbers from both parents; both maternal and paternal factors and chromosomes pair in the zygote and separate in the gamete.[18] (Fig. 27.)

If it be accepted that the factors in heredity are carried in the chromosomes, provided that the chromosomes are definite structures, there should be as many groups of characters as there are kinds of chromosomes. Morgan has demonstrated that there are exactly as many groups of characters that are inherited together as there are pairs of chromosomes, and also that it is possible to locate one of these groups in a particular chromosome and to state the relative position of the factors for the characters. In *Drosophila* (fruit fly) Morgan has found 125 different characters that are inherited; these characters have been arranged in four groups, the members of each group being inherited together. In *Drosophila* there are four pairs of chromosomes which agree with the four groups of characters. It should be noted that there are three large groups and one small group of characters, which correspond with the size of the chromosomes, three pairs are composed of large chromosomes, and one pair of very small chromosomes[17] (Fig. 28).

Many units are carried by each chromosome for the reason that the number of chromosomes is small compared with the large number of independently inherited characteristics (Morgan).

For example, in *Pisum sativum,* if the parents differ in one pair of characters, that is, one having round seeds, while the other parent has wrinkled, the ovaries of the one and the anthers of the other parent contain equal numbers of the materials which produce roundness and wrinkledness. Representing these materials by their initial letters, with capitals for the dominants and small letters for the recessives, the distribution of these materials in the hybrids is represented thus (Morgan):

Ovaries	Anthers
.....R	R.....
.....w	w.....

Since the materials in the ovaries unite with those in the anthers, and as there are two kinds of materials in both ovaries and anthers,

FIG. 27.—*A*, A black female guinea pig and her young. *B*, An albino male guinea pig, father of black young like those shown in *A*. *C*, Two of the grown-up young of a black and an albino guinea pig. Compare *A* and *B*. *D*, A group of four young produced by the animals shown in *C*. (*Castle.*) (Courtesy of the University of Chicago Press.)

it is equally likely that any one of the four following combinations may take place: RR, Rw, wR, ww.

R.....R
w.....w

Rw and wR are the same, hence the chances for the combination are 1 to 2. On account of the fact that all the hybrids receiving the materials RR will be round, while those receiving the ww will be

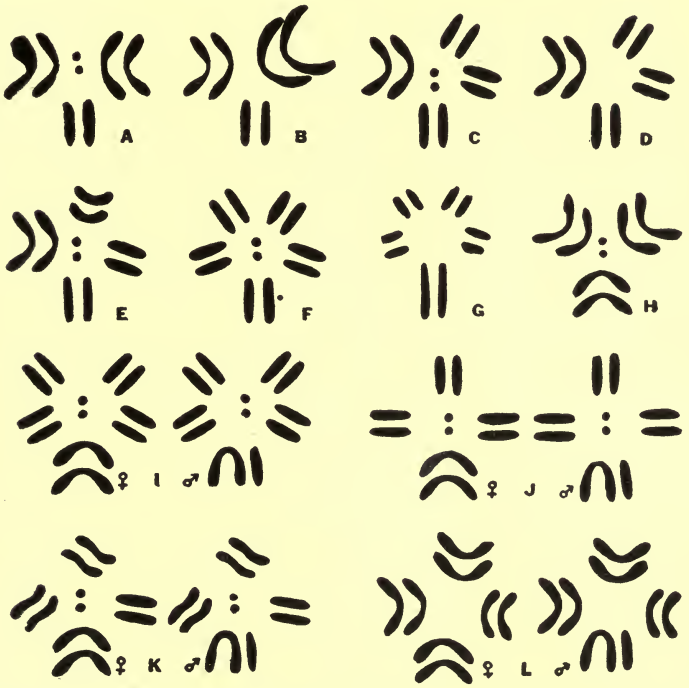

FIG. 28.—Types of chromosome groups found in *Drosophila*. A–H female groups; I–L female and male groups. In A, C, F, I, J, K, and L, the X-chromosome can be identified, because, in the male (Alex. Metz), the Y-chromosome has a different shape from the X. (*Morgan.*)

wrinkled, the chances are that three round seeds will be produced for one wrinkled; the progeny receiving RR should be pure and breed true, while those receiving Rw should be hybrid, the chances are that only one in three round seeds should breed true.

In hybrids containing in one the factors for red, and in the other the factors for white are brought together. In the germ cells of the hybrids the two factors (red and white) are separated—half the egg cells are white bearing, and half are red bearing.

Morgan's experiment with *Drosophila* (fruit fly) shows that in a cross between the wild type with long wings and a variety with vestigial wings, the flies in F_1 have long wings, as in the wild

variety. When two of the F^1 flies are inbred, the result will be three long-winged flies to one vestigial winged.*

If a yellow pea that is round is crossed to one that is green and wrinkled, all of the offspring will be yellow and round. If these are inbred the result will be 9 yellow-round, 3 green-round and 1 green-wrinkled. The yellows are 3 to 1 green, the round are 3 to 1 wrinkled; some yellows are wrinkled and some of the green are round (Fig. 29).

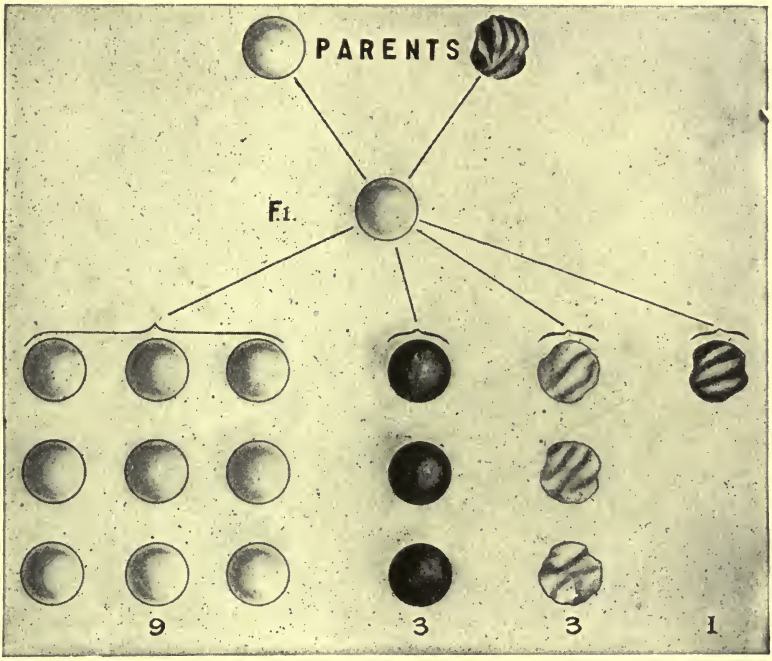

FIG. 29.—Diagram to show the inheritance of two pairs of Mendelian characters, viz., yellow versus green peas, and round versus wrinkled skin in garden peas. (*Morgan.*)

The characters have been combined anew, but the results of each pair of characters taken separately correspond with Mendel's first law, known as the law of segregation.

In some cases there is a kind of inheritance that is known as *sex-linked inheritance.* For example, if a white-eyed male is mated to a red-eyed female in *Drosophila* all the offspring have red eyes. If these are inbred, there are three red to one white-eyed offspring, but the white eyes only occur in the males. The grandfather has transmitted his character of eye to half his grandsons, but to none of his granddaughters (Fig. 30).

In the human germ cell, it is stated by some investigators that there are 48 chromosomes, and that in the sperm cell there are 47 chromo-

* *Loc. cit.*

somes. After maturation there are 24 chromosomes in the egg; among the sperm cells there are two classes; one with 24 chromosomes, which is female producing, and one with 23 chromosomes which is male pro-

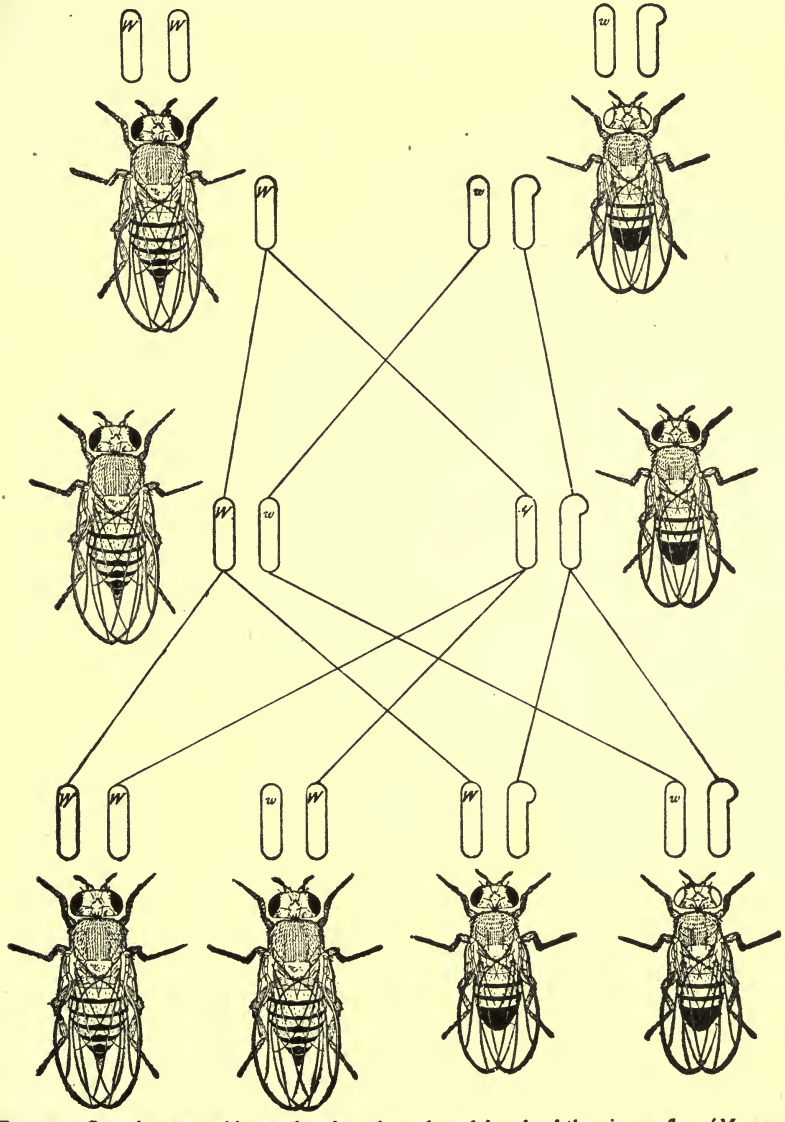

FIG. 30.—Cross between white-eyed male and a red-eyed female of the vinegar fly. (*Morgan.*)

ducing. This arises out of the fact that in one of the two maturation processes the X chromosome passes to one pole undivided.* If the factor for color-blindness is carried by the X chromosomes, its inheritance in man follows the same plan as any other sex-linked character.

Certain forms of color-blindness and hemophilia are transmitted in man as sex-linked characters. Among some domestic fowls sex-linked inheritance occurs as a type for several characteristics. If a black hen is crossed to a barred Plymouth Rock cock the offspring are all barred. If these are inbred, half of the daughters are black and half are barred, but all of the sons are barred. If, on the other hand,

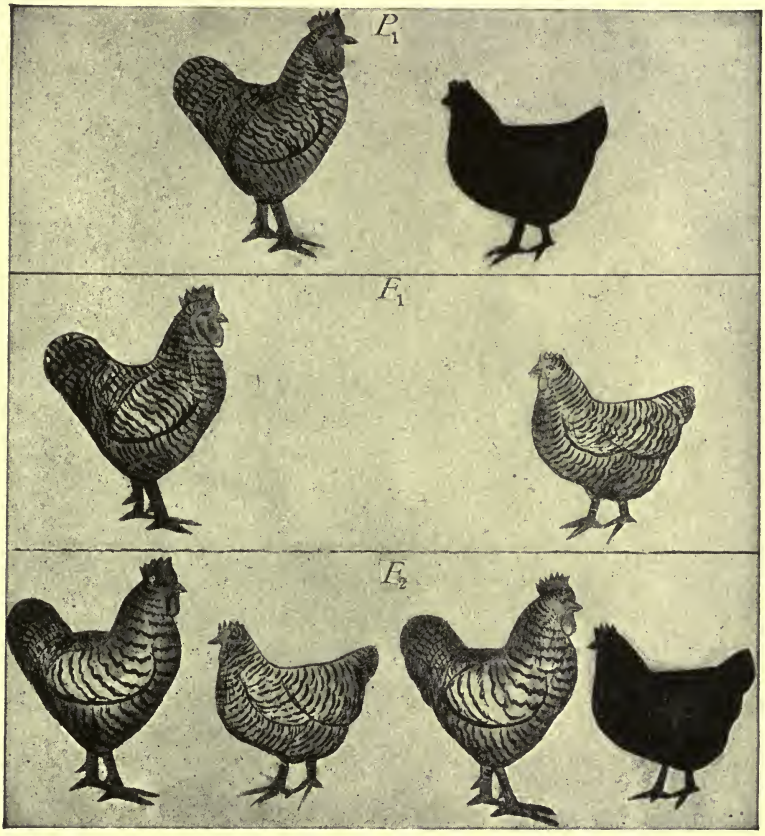

FIG. 31.—Cross between Barred Plymouth Rock male and Black Langshan female.

a black cock is bred to a barred hen, the daughters are black and the sons are barred (Fig. 31).

When a cross breed is made between a golden hen and a silver cock, all the chickens are silver. When a silver hen is mated with a golden cock, all the hens will be golden, but the cocks will be silver. In these instances the silver character is regarded as dependent upon the presence of a dominant factor, and the golden hue due to the absence of the factor. The silver male is a pure dominant, having received that characteristic from both parents (SS). The hen is heterozygous for silver, having received that character from only one parent (Ss).

The hen is also regarded as heterozygous for femaleness (Ff). The factor F and the factor S are not present together in any one egg. The eggs that are destined to become males carry the factor F.

In the same way that a "repulsion" between the factors for silver and femaleness exists, so do we find it in the human being, in the transmission of color-blindness, the sperms carrying the factor for maleness do not carry the factor for color-blindness; this factor is passed to the sperms destined to become females. Females are heterozygous for color-blindness but are not color-blind; to produce color-blind females the meeting of two affected germ-cells is necessary.

Nystagmus and night-blindness follow the same manner of transmission. Sons of all color-blind women are very likely to be color-blind.

The individual is frequently formed by the union of germ-cells that are not alike, in that one germ-cell may contain an element capable of producing a given characteristic, while the other germ-cell may not possess that element. In such instances the breed is spoken of as "crossed," or as heterozygous in that respect. Individuals may be grouped according to heredity into three classes:

(1) Those of pure breed, for the **presence** of a given characteristic, having received a two-fold supply of the necessary element from both germ-cells.

(2) Those of pure breed, for the **absence** of a given characteristic, both germ-cells being free from the essential element, and therefore transmitting none of it.

(3) Those of cross-breed, having received the necessary element from either one of the germ-cells.

One individual may receive the essential element, and thereby the characteristic, which seems to produce the full effect of that element. This characteristic is assumed to be **dominant** or positive, and to be due to the **presence** of something.

As has been pointed out, a cross breed of plants may result in producing all tall plants, although only one of the parents was of the tall variety. The hybrid may be as tall as another plant bred from parents, both of which were tall. Again a hybrid tall plant, when self-fertilized, can produce both short and tall varieties of plants. Dwarf plants, however, cannot produce tall plants, no matter whether the parents of one of the dwarfs was tall or not, for the reason that none of the elements which make for tallness is possessed by dwarf plants, and therefore cannot be transmitted by the dwarfs.[23]

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CHAPTER III

CEREBRAL DEVELOPMENT AND RECEPTIVE ORGANS

THE cerebral hemispheres attain their highest degree of development and complexity in man, and are adapted to meet the complex modes of the life of the individual.

The adaptive reactions in all animals may be divided into two groups: (1) Reactions which are in relation with the external world, and (2) reactions concerned with functions associated with nutrition and reproduction. The first includes all activities of the animal connected with obtaining food, and therefore involves bodily movements associated with defensive action; the second group of reactions is related to the physio-chemical functions, including metabolism, nutrition, growth and reproduction.

Every action is the result of either the direct or indirect stimulation of some part of the sensory apparatus at the periphery. The responses which initiate and control the bodily activities of the animal are considered functionally as separate from those which govern the internal or organic activities, and are named in accord with the anatomcal distinctions which indicate the type of apparatus concerned, hence, the **somatic** and the **visceral activities.**

In the phylogenetically complete cerebrum this organ is primarily sensory. In the advance in cerebral development the motor governing apparatus appears, and in the highest type of cerebrum, the commissural connections between those important areas of the cortex are added. It is only through these intercommunications established between the several portions of the cortex that higher functional efficiency is reached, as is true of all animals with complex brain mantles—which aid largely in bringing about the adaptive reactions of the individual.

In the lower animal orders, from cyclostomes in which the most primitive forebrain is found, to fishes, amphibia and reptiles, the cerebrum is largely concerned with the functions of smell and taste. These primitive cerebri are not connected with the exterior of the body and apparently are without somatic representation, except in some fishes, in which a cutaneous nerve can be traced to the forebrain, apparently the forerunner of the later evolved cortical representation of the soma (Johnston).

In most vertebrate animals the frontal lobes are insignificant compared with primates and man. In the human brain there has been evolved the cerebrum of the highest type, and also an organ of adaptation and defence in the broadest meaning of the term. In most animals the larger portion of the cerebral cortical substance is connected with somatic functions, supplying, in the form of a suitable nervous mechan-

ism, a provision with which to meet and to react to experiences as a result of contact with environmental objects of stimulation. In the human brain the portion of the brain mantle governing somatic activities occupies about one-third of the hemispheres. Here are represented the visual, auditory, olfactory, gustatory and general bodily sensations and voluntary movements, together with the anatomical representation of the interconnection of those functions known as the **association** processes (see page 49).

In infancy, nervous phenomena are of the simplest character; all of them, for a time, are dependent upon inborn reflexes.[1] Reactions to several kinds of stimuli occur at that time; most clearly manifest are those reactions to touch and taste stimuli, and less evident at first are reactions to sensations of sound. Rays of light falling upon the retina may either arouse no response at all, or one that is purely reflex and therefore unaccompanied by consciousness. A lighted candle held before the eyes of an infant, in the early weeks of its life, will be followed by movements of the eyes in the direction of the light when the candle is moved from side to side. The reaction in this instance is involuntary; the infant is in the same functional state, from the standpoint of its nervous system, as the invertebrate with the ganglionic nervous system, or like the vertebrate with its cortex removed, as the classic experiments of Goltz [1] have shown. The infant likewise may have visual sensations, yet it does not see (perceive). Perception requires for its achievement a further degree of structural and functional development of the nervous system which in the young infant is unattained until some time after birth.

This functional incompleteness of the results of such sensory phenomena is in accord with the anatomical fact that in the newborn, and for a time after birth, the nerve fibres carrying sensory stimuli are developed from the periphery centralwards, but only as far as the lower centres. This portion of the sensory pathway is developed (myelinized) during intra-uterine life, but the fibre pathways connecting the corresponding functional areas (centres) in the cortex are incompletely laid down.

Myelinization begins at about the fourth month (intra-uterine), and is not complete until about a year after birth as a rule. In peripheral nerves the neurilemma, which arises from the cells of the neural crests at about the third week, appears before the myelin sheath. In the central nervous system the myelin sheaths appear before the neurilemma in those places where the latter is present.

The origin of the myelin sheath of the nerve fibre is still an unsettled question.

Myelinization appears first in the nerve fibres that are phylogenetically the oldest.

According to some histologists the myelin originates from the neurilemma; others regard it as a differentiation of the outer layer of the

axis-cylinder; still others consider that the fatty material of which the myelin is composed is precipitated as the result of a reaction between the substances of the axis-cylinder and the neurilemma (Fig. 32). In the central nervous system, nerve sheath cells have been found similar to those which are found beneath the neurilemma of peripheral nerves, and which originate from the supporting (neuroglia) cells arising in the central nervous system.[2]

The motor and sensory cortex in the course of structural and functional development provides ultimately the means of connection between the brain mantle and the periphery, giving motor and receiving sensory impulses to and from the nerve endings.

According to Flechsig,[3] this area of the cortex occupies a little more than one-third of the entire brain mantle. Flechsig's observations were based upon the demonstration with selective stains of the first traces of myelin in the fibre tracts, and the time of its first appearance in the developing brain, as well as the order in which the myelinization process takes place in the various brain pathways. With the exception of the fibres of the olfactory tract, the first fibres developed as far as the cortex are the fibres in the paths conveying impulses from the extremities. These fibres appear myelinated at the beginning of the ninth month of intra-uterine life. In the higher forms of animals the laying of the myelin sheaths on the axis cylinders seems to be the accompaniment of the functional activity of the nerve fibres concerned. The majority of the fibres connected with a definite cortical area appear to be completed at about the same time (Fig. 33).

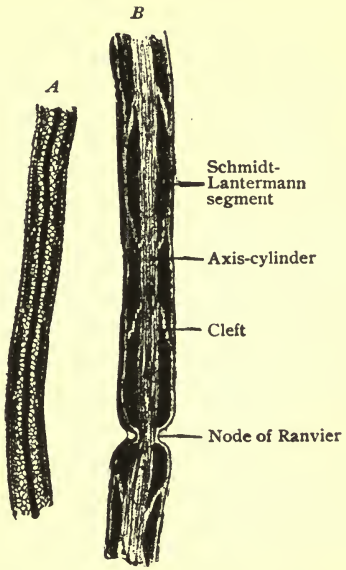


FIG. 32.—Medullated nerve-fibres after treatment with osmic acid; *A*, fibre showing reticulum within medullary coat; *B*, one showing same coat divided into segments. × 500. (*Piersol.*)

The fibre-paths to and from the various sensory and motor areas become myelinated in the order of their development, and those which are first functionally active receive their myelin first. The myelin appears first near the cells of origin of the axis-cylinder processes to be sheathed, and proceeds towards the end of the fibre, corresponding with the direction in which the impulses are carried (Fig. 34). The areas of the cerebral cortex related functionally to the fibre-tracts are indicated by the termination of those tracts in the cerebral mantle.

The Projection and Association Areas and Pathways.—The first of the cortical areas developed are the **primary sense areas** with their paths of conduction. These begin with the olfactory tract, lemniscus,

optic and auditory tracts, and are developed approximately in the order given. These tracts carry impulses in an ascending direction and are "projected" upon the cortex in their terminals in the sensory cells. The cortical-cell endings of the olfactory fibres are found in the uncinate gyrus. Visual fibres can be traced to the occipital cortex in the vicinity of the calcarine fissure. Of the sensations, vision has been more precisely localized in the cortex than any other (Lugaro). The

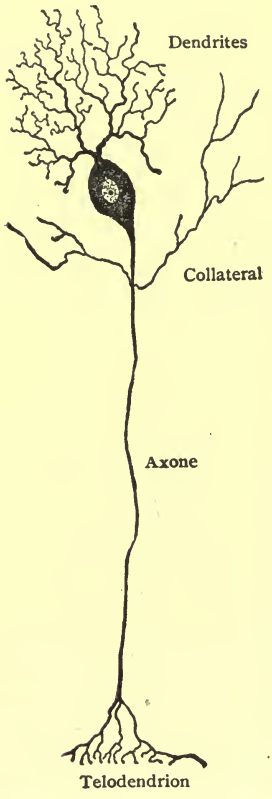


FIG. 33.—Diagram of typical neurone. (*Piersol.*)

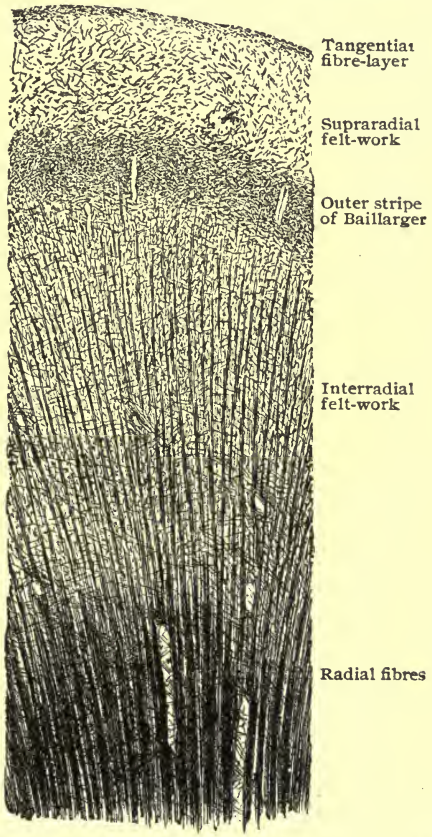


FIG. 34.—Section of cerebral cortex stained to show medullated nerve-fibres. × 21. (*Piersol.*)

fibres from the optic centres in the thalamus are myelinated after the majority of the fibres from the extremities, but before the last of these are completed. The auditory fibres are completed soon after the fibres of the visual pathway, and terminate in the temporal lobe of the hemisphere.

From other areas of the cortex pathways are later developed which can be traced downward ending in the motor cells in the centres in the medulla and spinal cord. These paths are known as

the pyramidal or motor tracts, and the cortical area from which they originate, namely, the Rolanic area, Flechsig regards as coextensive with the tactile area, and which he accordingly named the "somasthetic area." These paths of motion and sensation Meynert[4] named the "projection pathways," and their cortical representations the "projection areas" (Fig. 35).

At birth the projection motor and sensory cortical areas are rather widely separated from one another by masses of incompletely developed cortex, which totally comprises the remaining two-thirds of the brain mantle (Figs. 36 and 37).

After the fibres have become complete by development in these cortical areas, it is found, according to Flechsig, that they have only an indirect connection with the periphery. Their corresponding paths of fibres contain transcortical fibres only; that is to say, fibres arising in one part of the cortex and ending in another cortical area (Fig. 38). Concerning the function of these fibres experiment has furnished no reliable data. Their cortical connections are regarded as the regions in which the general sense areas are anatomically connected with one another, and the various sense impressions are functionally united to form complexes.

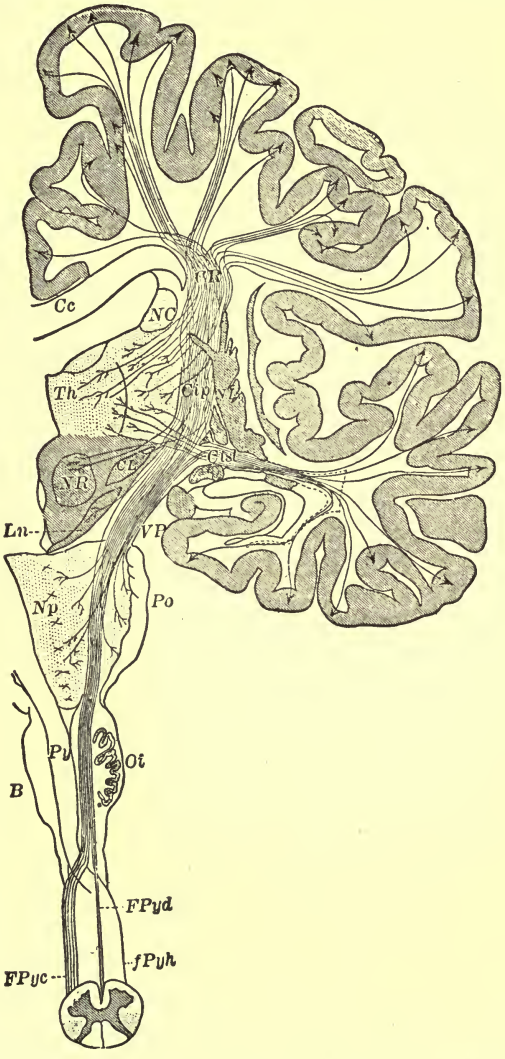


FIG. 35.—Scheme of projection fibres. (*Starr's Nervous Diseases.*) (Courtesy Lea and Febiger.)

It should be noted that these areas which Flechsig named the "association areas," are of slight extent in the lower mammals,

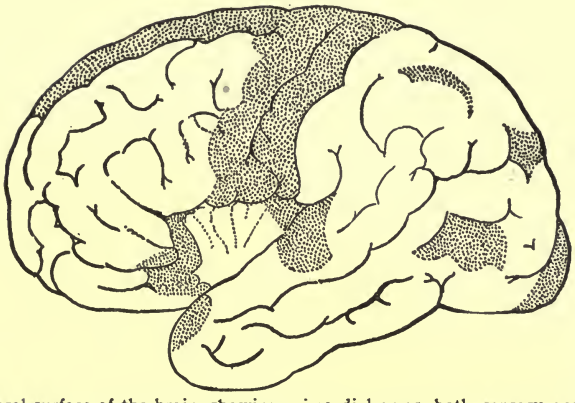


FIG. 36.—Lateral surface of the brain, showing primordial areas, both sensory and automatic, in dotted zones. (*Redrawn after Flechsig.*)

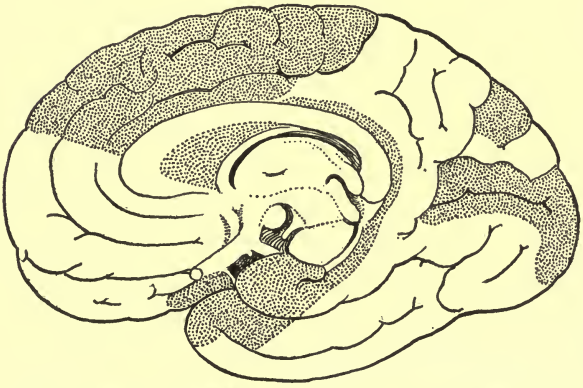


FIG. 37.—Same zones on the mesial surface of the brain. (*Redrawn after Flechsig.*)

FIG. 38.—Scheme of association fibre. (*Starr's Nervous Disease.*) (Courtesy Lea and Febiger.)

while in man they constitute the greater part, namely, two-thirds of the cortex. These areas are named association areas on account of the belief that they are the means of uniting the various sensory and motor areas of the cortex by means of the transcortical fibres which are termed the "association pathways." The greater development of these association areas is regarded as one of the features which distinguishes the human brain from that of lower mammals.[5]

The human brain would have to be three times its actual size if

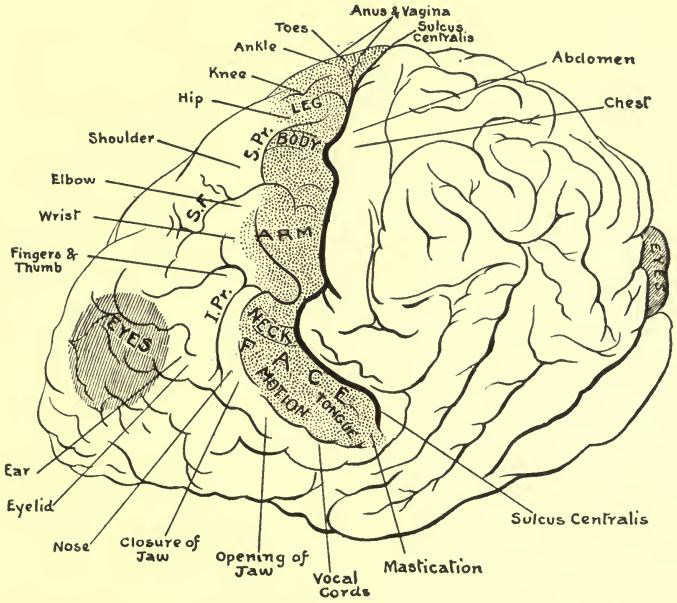


FIG. 39.—Surface of brain of chimpanzee, showing location of motor areas. (*Sherrington.*)

its surface were not convoluted. The gyri and fissures are causally independent. The brains of the higher type show an increase of cortex area, but not in thickness. The human brain is more convoluted than that of any primate because of the increase of neopallium to accommodate new functions, but it is not accompanied by any proportionate increase in intra-cranial space.

The horse, elephant, and probably the whale have more convoluted brains than man on account of the restricted intra-cranial space.[6]

The order of myelinization of the association areas and their paths corresponds with the order of the development of the more complex actions and mental states in the child.[7] The association areas are said to furnish reaction products which are the elaboration of products of the functions of the receptive (sensory) areas; they therefore furnish products of a higher psychic value, such as results from the fusion of a number of similar products.[8]

The experimental work of Sherrington and Greenbaum [9] (Fig. 39) and the histological studies of Campbell [10] (Fig. 40) and of Brodman [11] show that the motor area is confined to the Rolandic area in front of the central fissure. Faradisation of the human cortex has partly confirmed this, but is a means less dependable than the histological method. The opinion is now generally held that the motor area lies

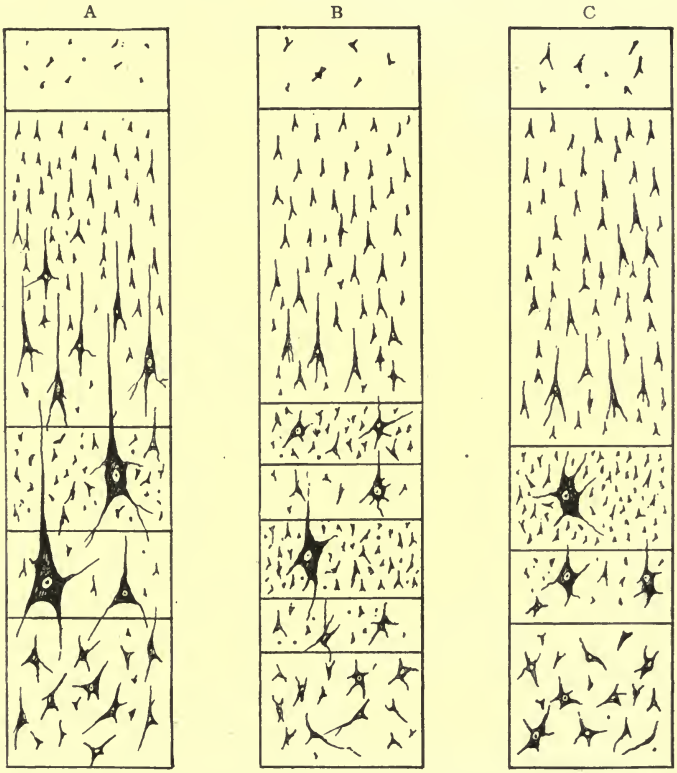
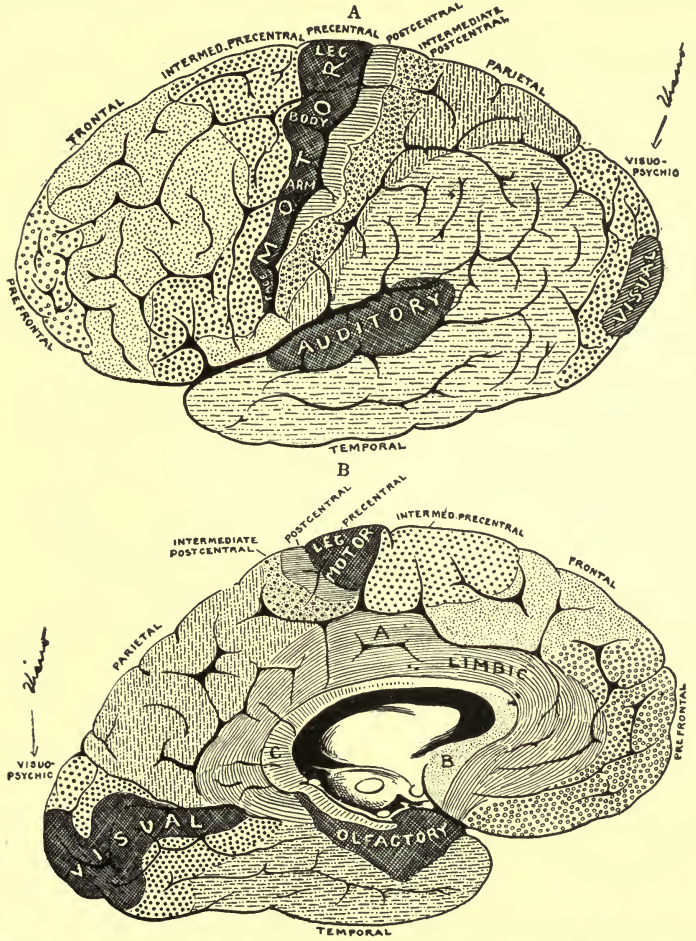


FIG. 40.—Diagram illustrating cell lamination in the cerebral cortex. *A*, motor leg area; *B*, visuo-sensory; *C*, visuo-psychic. (*Redrawn from Starling.*)

entirely, or almost entirely, in front of the fissure of Rolando. The cutaneous sense areas have been located by most of the recent investigators in the post-central gyrus. Vogt [12] found as a result of extirpation methods, together with stimulation of the cortex, that palsy without ataxia followed destruction of the precentral gyrus, and that ataxia without palsy followed destruction of the postcentral convolution. Victor Horsley,[13] after removing the prefontal cortex of the entire arm area, found the resulting disturbance partly motor and partly sensory. In opposition to this, Bolton[14] explains the apparent paradoxical results on the ground that it is practically impossible to remove the precentral gyrus without disturbing the functions of the immediate adjacent (sensory) gyrus and the intimate connections between these

areas (Mills). The stereognostic area and also that for the reception of muscle sense impressions are located in the superior parietal and inferior parietal convolutions.

The hypotheses which Flechsig based upon his observations and the generalizations which have been deduced from his investigations are



FIGS. 41–42.—Human brain showing outer (A) and mesial (B) surfaces, and the situation of the chief motor and sensory areas, as determined by a study of the histological structure of the cortex. (*Redrawn from Campbell.*)

not accepted by some workers in cerebral localization, but even Flechsig's critics agree that he laid the foundation for most of the finer localizations in the cerebral cortex.[14] Vogt found part of the projection system unmyelinated as long as there were parts of the cortex undeveloped, and that those undeveloped portions of the projection system correspond to the paths in which secondary degeneration is found after destruction of Flechsig's association centres. Vogt, therefore, concluded that the so-called association paths also contain projection

fibres.[12] One of the difficulties arising in the application of Flechsig's data is due to the fact that it becomes necessary to apply directly to the adult brain the results of investigations made with fœtal and infantile brains. Flechsig's work, as his strongest opponents believe, has nevertheless indicated that there are lower and higher centres in the cerebral cortex.

Studies of the cortical cyto-architecture by Campbell[10] and Brodman[11] with special reference to cerebral cell lamination have furnished important data connected with the matter of cortical localization. The results obtained by these observers are similar, but both differ from those conclusions reached by Flechsig, especially in the matter of the extent of the primary areas (Figs. 41 and 42).

Localization of Psycho-physical Processes.—All attempts at the localization of psycho-physical processes in the cerebral cortex have been largely the outcome of clinical observations of patients suffering from the effects of cerebral lesions, and of the study of anatomico-pathological findings in the brains of such patients. These observations, and the correlation of symptoms noted with the pathological findings, have furnished a certain amount of evidence indicating that the destruction of more or less definite areas of the cerebral cortex is accompanied by disturbance of certain functions; hence, the origin of such expressions as "intellectual areas," "stored impressions," "word memory centre," and the like. None of the complex psychical processes, with the exception of the function of speech which is disturbed in cases with lesions in the third left frontal gyrus have as yet been definitely localized.*

The so-called higher centres, notably those referred to the frontal lobes, have been called "psychic areas" on the ground that no sensory or motor fibres have been traced to this region, in contradistinction to other cortical areas which have been found to correspond with certain peripheral (somatic) regions, from the standpoint of functional control of sensory and motor phenomena (Figs. 43, 44 and 45). Concerning the association paths which connect the primary motor and sensory areas, the only data obtained which seem to have a definite foundation are those which concern speech. Localization of such mental processes as are concerned in memory and association is yet to be established.

As has already been pointed out, it is assumed on the basis of the investigations of Flechsig, that certain areas of the cortex are devoid of motor and sensory fibres; for example, the prefrontal lobes are developed at a late period and are usually regarded as reaching the greatest degree of development in man.

On the basis of the interpretation of the results of experiment upon animals, certain hypotheses in regard to the localization of psychic function have been advanced. For example, Bianchi[8] states that the frontal lobes can be considered as being neither sensory nor motor

* This has been opposed by Marie and others who regard the "lenticular" zone as the speech zone.

FIG. 43.—Left cerebral hemisphere illustrating diagrammatically motor zone and its subdivisions. (*Mills.*)

FIG. 44.—Diagram illustrating probable relations of physiological areas and centres of lateral aspect of left cerebral hemisphere. (*Mills.*)

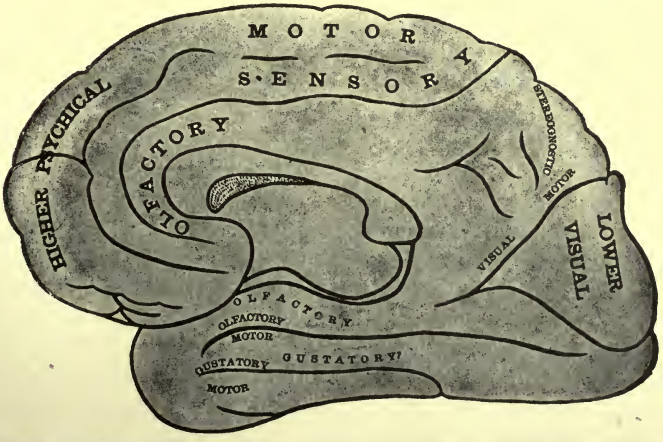


FIG. 45.—Diagram illustrating probable relations of physiological areas and centres of mesial aspect of right cerebral hemisphere. (*Mills.*)

for the reason that this region can be destroyed as far back as the prefrontal sulcus without loss of motion or sensation; also, persons injured in the region of the frontal lobes react to percepts, but become defective in the ability to arouse and associate images for the formation of proper judgments and the higher types of intellectual processes. As the result of experiment upon monkeys, Bianchi observed that an animal deprived of his frontal lobes will eat a piece of chalk cut into the shape of a lump of loaf-sugar. He reaches out for the cube, puts it into his mouth, chews and swallows it. The monkey with intact brain also takes the chalk, but examines it, smells it, tastes it and finally throws it away. In the instance of the animal without the frontal lobes, the sensations of sight, taste and touch are not impaired, if so, not sufficiently to prevent the rise of the percept, but there is lacking the ability to compare by contrast, the experience furnished by the piece of chalk with former experiences furnished by the loaf-sugar, and he therefore is unable to distinguish between the two objects of his sensations. Bianchi also found, after destruction of the frontal lobes in monkeys, a weakening of the sentiment of maternity, and of the former affection and attachment towards their caretakers.

Notwithstanding the apparently positive character of the evidence furnished by these extirpation experiments, the question of localization of the "intellectual processes" is still in an unsatisfactory condition. Luciani states, "Neither from Munk's experiments, nor our own, nor from those of Horsley and Schäfer, does it appear that after destruction of the prefrontal lobes the dog and the ape differ in any obvious way from intact animals in regard to their intelligence." Both physiological experiment and clinical observation have failed to furnish sufficient evidence upon which to base the conclusion that the higher psychical functions have a definite localization.

Scamiana removed the prefrontal lobes of two monkeys which had been taught certain complex acts, such as hunting for sugar in the pocket of the keeper and looking at themselves in a mirror. After recovering from the shock of the operation the animals exhibited no appreciable change in their behavior and were able to perform the complex acts they had been taught.

Numerous instances have been described in which no serious mental disturbance has accompanied extensive lesions of the anterior frontal region of the cerebrum in man.

Luciani [15] regards the posterior association area of Flechsig as of "special importance" in mental functions. The most important evidence in support of this comes from clinical data. Lesions situated in the region of the posterior association area produce the most serious intellectual defects, which is in accord with Flechsig's statement regarding the association areas (page 49).

As far as evidence which has been offered will allow the formation of a conclusion in regard to the location of the intellectual functions, it must be said that they "are not located in any one part of the brain, but depend upon the organ as a whole, and develop in proportion with

the gray matter of the cortex" (Luciani). See Conditioned Reflexes, p. 23.)

In recent years much interest has centred about the localization of the motor components of the emotional states, that is, the expression of the emotions. Spasmodic emotional expression, not true emotion, is seen accompanying subcortical lesions; also, as was long ago pointed out by Sir Charles Bell, lesions of the thalamus are accompanied by a loss of power of expression of emotion on one side of the face, while the purely motor function of the same is preserved. According to Head and Holmes,[17] the excessive response of affective stimuli in connection with thalamic lesions is not due to irritation in that region but to the removal of cortical control. Mills [16] states, "Usually when involuntary and spasmodic laughing and weeping are the result of a unilateral lesion, that lesion is somewhere in the right half of the brain. It may be a cortical or subcortical destructive lesion, or a lesion of the ruber and adjoining cerebral peduncle. It may be anywhere in or below the cortex before the decussation of the pyramidal paths." Dr. Mills believes that the cortical representation of emotion lies in the mid-frontal region, especially the right, which is an independent or anterior subdivision of the general motor zone, where are represented the movements concerned with the expression of emotion. These areas are regarded not as centres of emotion but of emotional expression. Just as the primitive motor zone in the left hemisphere has an evolutional outgrowth anteriorly corresponding to the cortical motor centres for speech and writing, so has the zone for representation of emotional expression.

Physiologists and psychologists are not ready to accept definite localization for the processes of thought, especially those through which mental contents are made clear (apperception), and although the actual part played by these areas (association) has not been established, they are regarded as "necessary links in the chain of physical processes which run parallel to the psychical processes in question" (Wundt).

The psychologist regards the expression "centre" as employed only to convey the idea of the physiologic component which parallels the psychologic. The fact that the frontal region, the largest of the association areas, is best developed in the human being, and also that in most instances, when subjected to injury or other disturbances, there follows a reduction in the more complex mental processes, is strongly suggestive of their functional importance, from the standpoint of the fusion of mental components.

It is, nevertheless, well to be careful in the interpretation of the terms "deposited memories," "stored images," and the like, in order to avoid the danger of applying these terms too literally. One may use such expressions, however, if the two points of view concerning the world of experience are regarded in the sense of a parallelism, the one from the standpoint of the "natural sciences," the other from the psychic point of view.

From the clinical point of view, which here will be the biologic aspect, we shall regard the nervous system as an adaptive structure which by a process of differentiation and elaboration has gradually become a mechanism of great complexity, and that during the lifetime of the individual the receptive organs are constantly impinged upon by the effects of external agencies, with constant reactions to their effects. Like the simple protoplasmic mass of the lowest organism, the highest developed nervous system owes its functional importance to the capacity it possesses for reacting differentially to external stimuli, with the distinction, however, that differential sensitivity plays a greater part in the highest type of mechanism.

It is important to note in the beginning, that the reactions of the individual indicate that some impressions are selected for response while others seem comparatively ineffectual. The responses are chiefly those which concern the welfare of the individual, *i.e.*, for benefit or harm; hence the nervous system becomes a mechanism of adaptation and defence, and of adjustment to the environment, which is the total biologic aim of every living thing.

Sensory Organs

It has been demonstrated experimentally that animals in which no tissue differentiation has taken place in the form of nervous elements react differently to different kinds of stimuli (vide Chap. IV). As the developmental scale advances we find special organs for the reception of special kinds of stimuli.

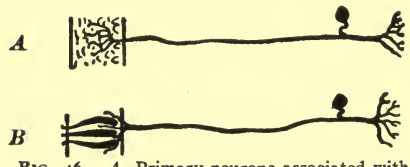


FIG. 46.—*A*, Primary neurone associated with the mouth surface of a vertebrate and concerned with the common chemical sense of that surface. *B*, Primary sensory neurone and taste bud in vertebrate mouth. (*Parker.*)

The mechanism of adjustment comprises the apparatus by which the individual is able to respond to external stimuli, while at the receptive end of the system there is furnished to the individual a means by which he gains experience with reference to the external world. All knowledge of environment depends upon experience derived through the "special senses." All sorts of things may exist outside of our bodies, yet we may have no knowledge of them unless our sense-organs are affected.

There is a primitive chemical sense in some marine animals seemingly allied to taste and smell which is one of the earliest developed; the senses of taste and smell in higher animals appear to be developments of this (Fig. 46) primitive chemical sense. The greater the number and variety of mechanisms for distinguishing external forces, the better are organisms adapted for adjustment to environment, as in the case of organisms possessing the so-called "distance receptors," *e.g.*, for smell, hearing, and vision, which are concerned in the higher or psychic activities.

Five kinds of special senses are commonly distinguished: touch,

taste, smell, hearing and vision, with modifications, especially of touch, in the form of pain, pressure, temperature and the sense of equilibrium.

Tactile Sense Receptors.—Touch sense is developed in some degree in all animals, particularly in those with an epiderm. Many animals have special projections in the form of tactile hairs and tentacles, as in polyps and worms, and as antennæ in some mollusks (snails) and in arthropods. In vertebrates only occur the typical pit or canal organs, found on the head and sides of the body, as in cyclostomes, fishes and amphibia of the aquatic type. These tactile organs are composed of pear-shaped cells with projecting hairs which extend beyond the surface of the ectodermal covering. These are the sense-

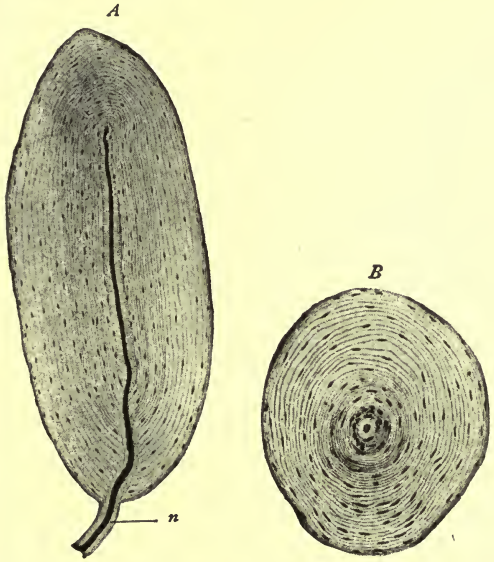


FIG. 47.—Vater-pacinian corpuscles from skin of finger; *A*, longitudinal; *B*, transverse section; *n*, nerve entering capsule to reach inner bulb. × 145. (*Piersol.*)

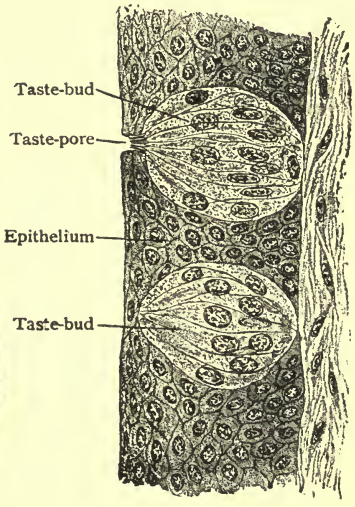


FIG. 48.—Taste-buds in section; upper one shows gustatory hairs projecting into pore-canal. × 440. (*Piersol.*)

cells and serve the purpose of receiving vibrations, which, in water, are of less frequency than the number of vibrations necessary for the production of sound, namely, are from six to one hundred per second.[7] Closely associated with tactile receptors are the organs of equilibrium, or position receptors, and in the lower animal forms, taking part in that function. This equilibratory function, in higher animals, is connected with both the auditory and visual functions, as is shown in the sense of dizziness one experiences accompanying disturbances in the internal ear; also when one attempts to move about after the eyes have been blindfolded. Specialized tactile sense-cells, or "endings" of the corpuscles of Vater and Meissner (Fig. 47) types, found beneath the epithelium, occur in vertebrates, and are associated with deep sensibility.

Gustatory Sense Receptors.—In the same way that nerve centres

are connected with the cutaneous endings from which touch impulses are transmitted, stimuli from the viscera are brought from the periphery to the central nervous organs, through their terminals in the mucous membranes. The particular pathway of this sensory function has its peripheral representation in the gustatory end bulbs (Fig. 48). The extent of the body surface concerned in these visceral sensory impulses varies greatly in different animals; it is much greater in the lower vertebrates, and especially in gill breathing animals, which possess a great many taste organs in the head; in amphibia we find that these organs are limited to the terminals of the branches of the facial, glosso-pharyngeal, vagus, and possibly the vidian branch of the fifth nerve.

These nerve centres are best known in

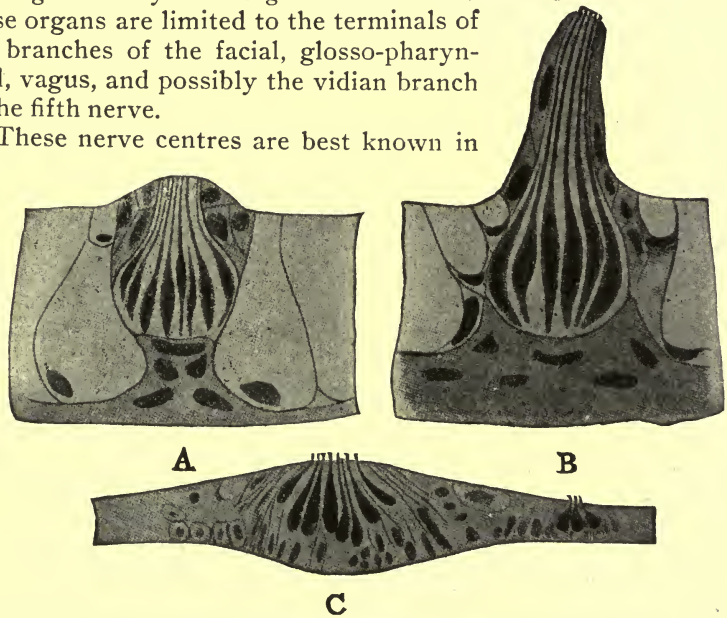


FIG. 49.—Taste organ from the skin of fish. (*Johnston's Nervous System of Vertebrates, P. Blakiston Son & Co.*)

fishes on account of the wide distribution of their nerve pathways. Special taste organs in adult fishes are found practically all over the body, in its ectodermal portions, and possibly, in addition, the ectodermal area of the mouth and pharynx. Taste-organs differ structurally from the smell-organs in that the former occur in the shape of elevations, while the latter are depressed in pits (Fig. 49) (Johnston). Taste sensations are related to visceral activities as are tactile sensations to bodily or somatic activities. Just as tactile sensations are to bodily activities, so are taste sensations to visceral functions.

Olfactory Sense Receptors.—Olfactory sensation is physiologically so closely related to gustatory sensation that it is sometimes difficult to distinguish the two classes of experience. From the morphological standpoint, there are distinctive differences, especially in that the structural elements are located beneath the surface epithelium, in the

so-called olfactory sacs, containing slender spindle-shaped cells connected with nerve fibres, which never become myelinated, and which run to the brain as the olfactory nerve. These sense-organs are distance receptors of a high order of importance in lower animals.

In fishes the forebrain is concerned solely with olfactory impulses, the centre for which is in the olfactory lobe. It is in air-breathing animals that the olfactory apparatus comes into anatomical relation with the pharynx. The olfactory and the gustatory cells are classed together with visceral ganglion cells as the **primary visceral receptive cells** (Fig. 50).

Recently experiments have been conducted which seem to show that snails are provided with olfactory sense apparatus, though morphologically it has not been demonstrated.

FIG. 50.—Section of human olfactory mucous membrane, silver preparation; two olfactory cells are seen, one of which sends nerve-fibre towards brain. × 335. (*Brunn.*)

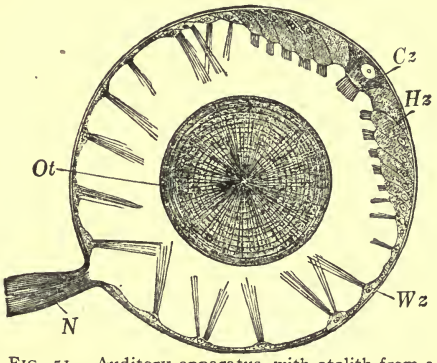


FIG. 51.—Auditory apparatus with otolith from a mollusk. (*Kingley's Hertwig.*) (Courtesy Henry Holt & Co.)

Auditory Sense Receptors.—As has already been noted touch impulse endings in the ectoderm are closely related functionally with the auditory apparatus. Morphologically the sense-organs concerned in the reception of sound impulses are cutaneous organs, as is indicated by the fact that they all possess hair-like cells, that they develop as sunken pits in the epidermis, that they respond to vibrations of the fluid which fills the canal in which they are placed, and that their nerve fibres and cells are similar. The simplest ear consists of an epithelial sac containing a fluid (endolymph) and an auditory ossicle (otolith) attached to cilia which project from the epithelial cells. These are also organs of equilibrium (statoliths) for these animals (Fig. 51).

These hair cells respond to vibrations of a much greater rate than do the cells of the simple cutaneous sense-organs, on account of the fact that the auditory cells are more deeply embedded in the canals and thus escape the slower vibrations. In the lower vertebrates, especially fishes, the auditory apparatus and the somatic impulses concerned in the function of equilibration are much more closely related than in higher animal forms, in which the peripheral and central portions be-

come anatomically differentiated* (Fig. 52). Some investigators have tried to prove that in invertebrate animals all auditory vesicles are in reality organs of equilibration, at least to a large extent. Spiders and insects which seem to hear well are assumed to possess auditory organs of another type because they do not possess auditory pits or vesicles.

Visual Sense Receptors.—The phenomenon of reaction to light is found widely distributed throughout both the animal and vegetable kingdoms. In animal organisms possessing no specialized apparatus for the reception of light stimuli, the reactive phenomenon is manifested by either attraction or repulsion—positive or negative phototaxis. In

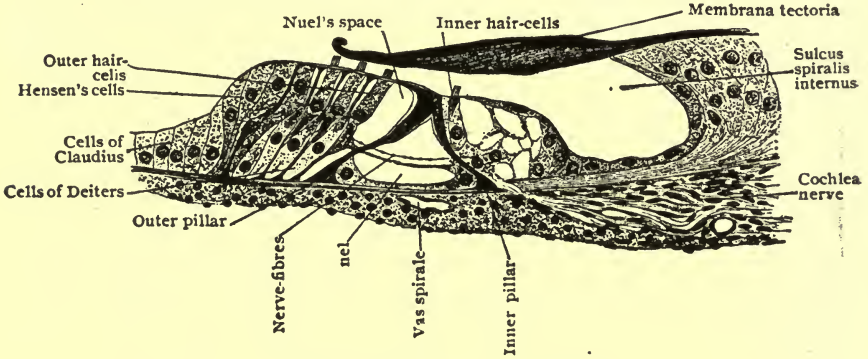


FIG. 52.—Organ of Corti. (*Piersol.*)

amphioxus, and in the common earthworm, which possesses visual cells beneath a translucent epiderm, this phenomenon is well marked.

Pigmentation of visual cells is not essential, although this usually is the case, and is apparently an aid to light sensitivity. The presence of several layers of pigmented cells constitutes a retina (Fig. 53).

The simplest eyes consist of localized pigmented cells which may serve only the purpose of differentially reacting to light and darkness. These pigmented eye-spots may exist either with or without a lens, for the concentration of light and the formation of an image, as in vertebrates, and possibly in cephalopods (Squid).

In some vertebrates it can be shown that light stimuli affect the nerve endings of the skin. Light stimuli applied to the skin of a frog with enucleated eyes will cause the animal to turn its head or even to jump towards the light. If, however, the body of the animal be protected from the light by a covering, no such reaction takes place. In larval forms of lampreys, although they have rudimentary eyes, the tail seems more sensitive to light than the head, which fact is useful to the animal to determine that it is completely buried in the mud in which it lives and in which it burrows head first.[7]

In all animals with completely developed eyes, the relationship which exists between the central nervous system and the visual appara-

* The cochlear and vestibular portions of the auditory nerve and internal ear.

tus is shown by the indirect outgrowth from the brain vesicles and by the similarity between the histogenesis of the retina and that of the neuronic elements of the brain and spinal cord. This important relationship which exists between the sensory impressions received by the visual organ and the central nervous organ is thus emphasized. In fact, the optic nerve has been regarded by morphologists, not as a true peripheral nerve, but as a central nerve tract, and the retina accordingly is regarded as a part of the brain wall. These facts seem to indicate that the entire ectoderm was originally sensitive to light and that in the first vertebrate the cephalic portion developed the greatest degree of this sensitivity, hence the development of the complete visual organs.

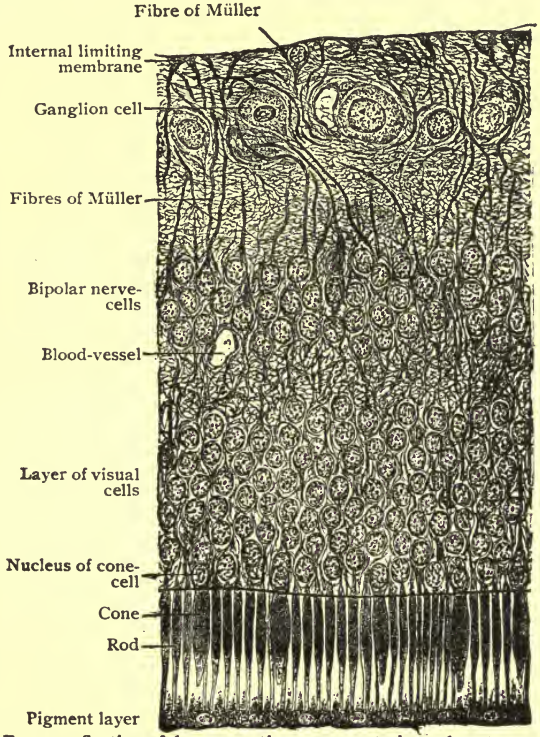


FIG. 53.—Section of human retina near posterior pole. × 230 (*Piersol.*)

Cells specially sensitive to light in amphioxus are contained in the front end of the brain and also in the entire spinal cord.

In mammals whose fields of vision do not overlap, due to the fact that their eyes are placed on the side of the head, the crossing of the fibres in the chiasm is limited to relatively few fibres.

Both the auditory and visual forms of sense are spoken of as the "higher senses" in their more important position of supplying the individual with knowledge of his environment, and are the means of gaining experience of a definite character in the instance of visual sensation.

The Autonomic or Vegetative Nervous System.—The terms "autonomic" and "vegetative" nervous system have been given to a part of the nervous mechanism, because of its apparent independence in functional activity of the cerebro-spinal or sensori-motor apparatus. The term "vegetative" is used in contrast to animal sensori-motor mechanism, and is regarded by the Vienna school as comprising (1) That entire system of nerve cells and fibres supplying organs containing smooth muscle; (2) those nerves supplying and exerting a secretory

influence upon glandular structures; and (3) those fibres supplying the heart muscle, the beginning and end of the digestive tract and the genital apparatus. (Fig. 54.)

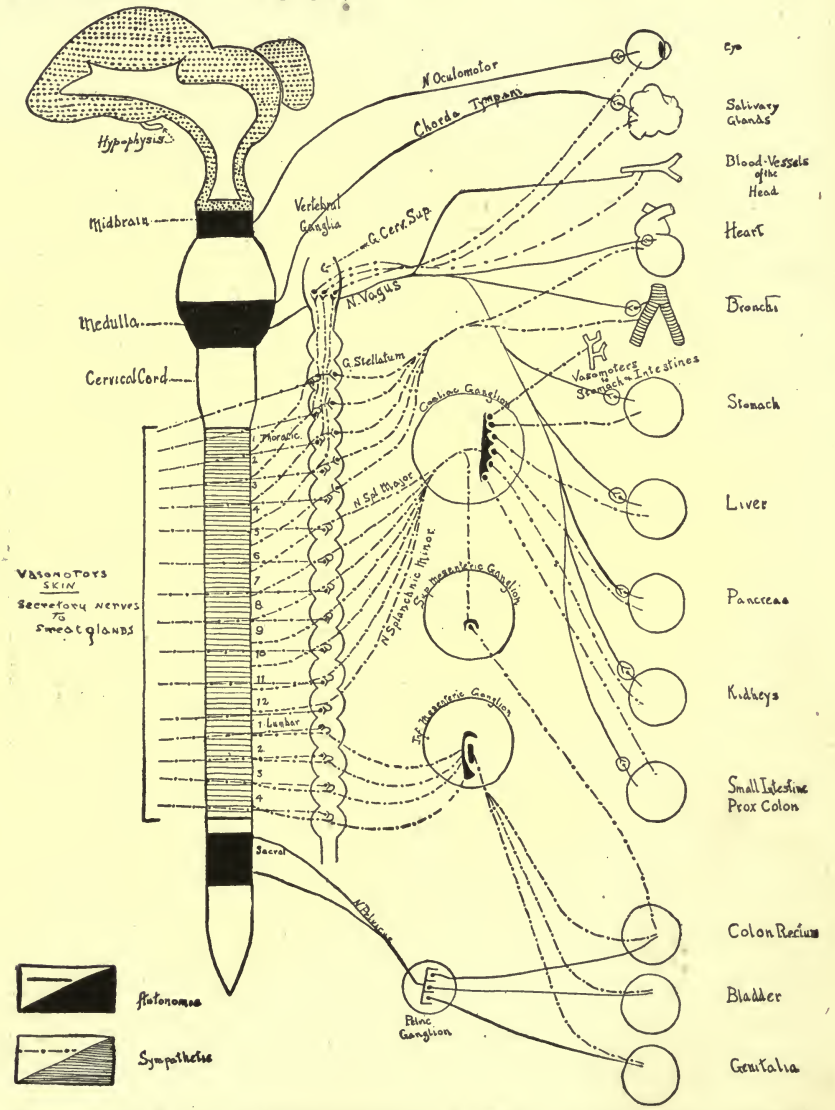


FIG. 54.—Distribution of the various divisions of the vegetative nervous system. Sympathetic pathways in dotted lines. Autonomic paths in unbroken lines. (*Jelliffe and White.*, modified by Kraus from Meyer and Gottlieb). (Courtesy Lea & Febiger).

The term " sympathetic system " properly includes only the ganglionated cord on each side of the vertebral column, with its connecting ganglia and nerve fibres. Under the present system of nomenclature,

the latter would constitute the "thoracic autonomic or vegetative" fibres which arise from the eighth cervical and subsequent segments of the spinal cord down to and including the second lumbar.

The nuclei of origin of the vegetative system are not easily distinguished from the nuclei of the cerebro-spinal sensori-motor nerves, because they lie close together in the mid-brain, medulla and spinal cord, the principal differences being found at the periphery. The sensori-motor nerves have but one neuron, while the vegetative nerves have ganglia interrupting the afferent and efferent paths. The autonomic fibres are subdivided as follows: (*a*) Those from the mid-brain by the oculomotor pathway, interrupted by the ciliary ganglion, supplying iris and ciliary muscle; (*b*) bulbar autonomic, arising from the fourth ventricle in vicinity of calamus scriptorius, by way of facial and glossopharyngeal nerves to glands and vasodilators of head, and by the largest and most important branch, the vagus, to heart, bronchi, esophagus, stomach, pancreas and intestines; (*c*) sacral autonomic, leaving the cord by the first three segments as pelvic nerves to ganglia supplying the descending colon, anus, bladder and genital apparatus.

If we include the thoracic ganglionated cord there are to be considered four autonomic divisions of the vegetative system: the mid-brain, the bulbar, the thoracic (sympathetic proper) and the sacral. The vegetative organs are supplied by the nerves of the sympathetic, and by fibres which come from one or the other three divisions. An exception to this is found in the muscles of the visceral blood-vessels, which appear to be supplied from the ganglionated cord alone.

Eppinger and Hess [18] have made an extensive study of the vegetative nerves and recognize a functional distinction between the sympathetic and the remaining divisions, termed the autonomic. They conclude that a physiological antagonism can be demonstrated by certain drugs. For example, adrenalin, according to these investigators, acts solely on the sympathetic, and in the same manner as stimulation of these nerves by other means. The autonomic nervous system can also be influenced separately by such drugs as atropin, pilocarpin, physostigmin and muscarin; the drugs of the atropin group, however, act as paralyzing agents. Drugs which stimulate the latter produce on the sympathetic a paralyzing effect. No drug substance has been found to strictly or individually produce this influence. The importance of the autonomic * system seems to have its greatest bearing in connection with mental states shown in the

* The term autonomic implies a certain degree of independence, but the system is not to be regarded as an independent central nervous system, but rather as an "outflow" from the cerebro-spinal system. It should also be noted that the autonomic system is entirely efferent and governs the "organic" functions of the body [20]. According to Gaskell [20] the nonstriated muscles of the vertebrate animal are divisible according to their distribution, function and other characteristics, into groups: (1) The vascular, (2) the cutaneous, (3) the intestinal, (4) those around the segmental duct, (5) the sphincters of the intestines, (6) those concerned in the visual mechanism.

form of the psychomotor reactions which accompany the various emotional states. The rapid heart action accompanying joy and fright, the pallor and the dryness of the mouth, vomiting and diarrhœa of fear are important examples, of which there are counterpart states in the abnormal, as occurs in mental depression and excitement. Fear, anger and joy are the accompaniments of sympathetic stimulation. States of depression accompany sympathetic depression, and also the complementary state of autonomic stimulation. In the normal there is a balance established between the two systems, and any stimulation of the one is accompanied by a corresponding depression of the other.

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CHAPTER IV

MENTAL DEVELOPMENT

THE development of mental functions in man is a much slower process than in animals, which is in accord with the fact that the period of immaturity in man is longer than that of any other animal. Mental organization begins in all instances in a very simple manner, develops slowly and is evolved in a more or less definite order.

By observation of the activities of organisms, noting the effects of external stimuli, that is, by the study of the reactions or behavior of animals under experimental conditions, certain data have been obtained which are suggestive of the mode of development of mental functions. The important deductions which have been made are: (1) The development of mental activities parallels that of the physical; (2) the development of psychic activities is dependent upon the pre-existing fundamental activities in the germ (Conklin).

Fundamental Reactions.—In the embryo, and also for a time during infancy, mental functions are practically absent. Biologic investigation has furnished evidence which indicates that at least the essential characteristics of the fundamental psychic phenomena, as developed during infancy, are traceable to those properties of the germ designated as sensitivity, the retention of the effects of stimuli, reflex movements and tropisms (Figs. 55 and 56).

The most elementary and essential property of an organism is the property by virtue of which its protoplasm is capable of being affected by stimuli. Furthermore, it is necessary that the organism shall be able to react in response to stimuli. In referring to the behavior of living things these phenomena are termed **sensitivity** and **irritability**, which are vital characteristics of organisms. In any of the available organisms, such as amœbæ, infusoria, various bacteria, eggs-cells and spermatozoa, sensitivity can be demonstrated as a fundamental functional characteristic. The behavior of amœboid cells, leucocytes, and other freely moving organisms, especially paramecia, varies considerably under different kinds of stimulation. For example, organisms move towards or away from light, heat, electrical and chemical stimuli; they also respond differentially to stimuli of one kind applied with varying degrees of intensity. This capacity for reacting in different degrees, according to the quantity or intensity of stimulus, is termed **differential sensitivity.**

Cells which are incapable of movement as a whole may exhibit the effects of external stimulation by reactive movements within their

bodies as occurs in the protoplasm of egg-cells after penetration by the spermatozoön. Similar movements have been observed by Loeb after pricking the egg-cell with a needle. Movements within the egg-cell and other embryonal cells have an important bearing on the process of differentiation of somatic structures, such as epithelium, connective and muscular tissues.[1]

As development advances specialized organs (receptors) appear for

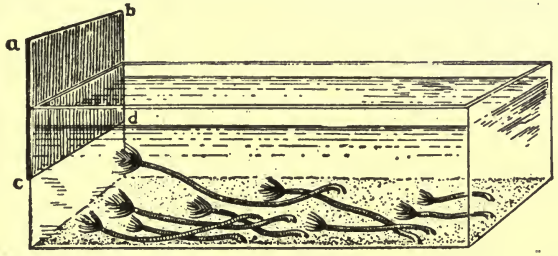

FIG. 55.—Tube worms in aquarium, all bending toward light. (*Loeb.*)

the purpose of receiving external stimuli. Through adaptability and consequent activity of these sensory organs differential sensitivity reaches a higher degree of development the farther we rise in the animal scale. Differential sensitivity, so well developed in the higher animals and in man, is inseparably connected with psychic processes; in fact,

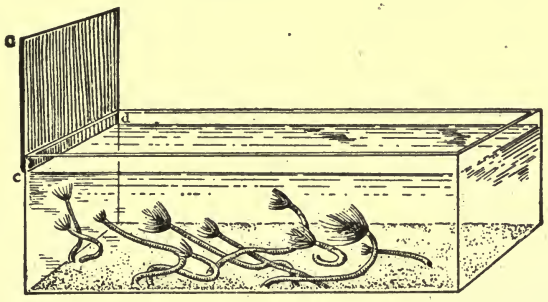

FIG. 56.—The same animals after the position of the aquarium to the window was reversed.

sensitivity is the basis upon which all mental functions develop and operate, as it is for the physiologic functions.

Reflex Movements and Tropisms.—In animals with nervous systems all forms of activity are the end result of reflexes, or are the outcome of tropisms. That is to say, the movements of organisms depend upon a neural process which has its beginning in an excitation of a receptor and thence is carried to a neurone or series of neurones, and ultimately reaches an effector—a muscle or gland-cell. Reflexes are reactions of isolated portions or segments of the organism (Loeb). When structural differentiation has reached the degree in which there are formed specialized receptors, the reactive movements become more numerous and more complex, as are seen in the movements of the fœtus

in utero, commonly spoken of as reflexive movements. In these movements activity is the result of a complex of reflexes.

Another class of movements which occur as reactions of the organism as a whole is that of **tropisms** or "forced movements." These movements occur in plants and animals, as in the "sensitive plant" and the Venus fly-trap; movements may be brought about by stimulating the sensitive hairs on the leaves. The reactive movements of bacteria, protozoa, germ-cells and other simple organisms, commonly termed automatic movements, are dependent upon peculiarities of individual organization. In more complex animals forced movements are brought about, as has been shown by Loeb and others, as the result of the unequalizing of muscle tension of symmetrical muscles, exemplified in the "circus movements" produced in laboratory animals by injury to one of the cerebral hemispheres, or cutting off illumination from one eye.[2]

The complex responsive movements which appear immediately after birth, such as sucking and crying, are the result of complex reflexes and are classed as instinctive movements (see Genesis of Movement, Chap. V).

Retention of the Effects of Stimuli.—Protoplasm is capable of being irritated by stimuli; it is able to respond to stimuli, and after being subjected to stimulation possesses a property which it did not previously possess. This property depends upon its inherent capacity for "storing up" the effects of stimuli, which constitutes a characteristic of fundamental functional importance. Several stimuli may be required in order to produce a certain kind of response, as in the example of the movements of the Venus fly-trap; several stimuli applied in a series during a given period will produce a greater degree of shortening in muscle-cells than a single stimulus continued for the same length of time. This delay of reaction gives the appearance of the effect of one stimulus being held over until the subsequent stimuli are received. This phenomenon is known as the "summation" power of protoplasm and constitutes an important characteristic of nerve-cells. The so-called automatic movements which by practice we acquire with effort, for example, talking, walking, bicycle-riding and piano-playing, are considered as made possible on account of the summation power in muscle- and nerve-cells, and are regarded as the result of the *persistence of the effects of previous stimuli and activities.* This has been given the name "organic memory" and is analogous to that which we ordinarily term memory, when we speak of the power of "recollection," in referring to the reproduction of past sensory, motor and other mental experiences.

Effects of Experience on the Organism.—It has been shown by experiment that organisms brought into contact with substances which are injurious or irritating to their bodies avoid those substances when given the opportunity; this "avoiding reaction" is dependent upon the

property of differential sensitivity. Paramecium, when brought in contact with strong acids or salts, will swim backwards and then forwards in a new direction as if "trying its environment" until it is able to find an environment in which the irritant ceases to act upon it, or at least one that is more favorable. The paramecium thus finds an unirritating medium by a process of "trial and error," and reacts in accordance with whether its environment is injurious or not as the result of its previous experience. This action gives rise to results which serve the same purpose as when the human subject forms judgments based upon past experience, with the aid of consequent additional knowledge, gained by the mental processes commonly termed "reason" and "intelligence." The inexperienced individual continues to injure himself until he learns by trial and error that which is injurious and that which will not injure him.* Some biologists are inclined at present to regard the two processes as being at least fundamentally closely allied.

On account of the fact that the expression "trial and error" is open to criticism by those who might regard the term as indicative of a "striving after ends," Conklin suggests the use of the term "useful and adaptive reactions" to indicate that many of the reactions of animals, which are apparently purposive, are in reality the outcome of the elimination of useless responses. Dogs, cats and horses show a certain degree of intelligence in their ability to carry out complicated acts, such as learning to open a door by pulling a string or pressing a latch, but it has been shown that these animals are not able to apply that knowledge to new situations and therefore cannot be regarded as exhibiting reason.

Choice of Response.—It has been emphasized that all responses are the outcome of contact with environment, and its changes, and its effect upon the organism. If an organism is stimulated by more than one form of irritant at the same time, it obviously cannot respond to all the stimuli at the same time, especially if these stimuli are such as tend to bring about reactions which are opposed. Some modification of the usual response should, in the appearance of things, occur; or, one kind of response will be *inhibited* while the other reaction is carried out. In such instances the usual effect of the simultaneous application of more than one stimulus results in one stimulus neutralizing the other. The stronger stimulus may outweigh the effects of a different but weaker stimulus.† By forcibly preventing certain usual responses, and by limiting the responses to a single movement, the production of a habit may be the result, as in the training

* The same phenomenon is observed in the mentally disturbed patient impelled by reason of hallucinatory experiences to endanger himself as the result of necessary reactions to those sensations.

†We see this illustrated in the patient who by reason of active hallucinations or a single, persistent idea cannot give attention to and therefore does not respond to real stimuli.

of animals. Thus, by holding all the arms but one of a star-fish, Jennings [3] was able to train the animal to use repeatedly the same arm in righting itself when placed on its back. The behavior of animals is governed largely by the fact that one kind of response is found by experience to be more favorable to the animal, and, although several kinds of stimuli may be applied the same response is repeated. In mental processes the corresponding reaction involves a choice, and results in a *voluntary* act.

After such comparisons of the sensory and motor reactions of lower organisms with the mental processes of higher animals there naturally arises the question concerning whether amœbæ, paramecia and many other low forms of animals are in any degree possessors of states of consciousness. To this the answer must be given that the fundamentals upon which basis consciousness may arise are present in all organisms, but that conscious states are not developed except in the individual supplied with the necessary mechanism to react upon a proper environment. In the germ-cells the necessary elements for the development of consciousness are present, "not as a miniature of the adult condition, but rather in the form of elements or factors, which by a series of combinations and transformations, due to interaction with one another and with environment, give rise to the fully developed condition." [1]

There are many reasons for the supposition that among higher animals in general and in human beings in particular many reflexes which appear as factors in conditioning states of consciousness originate from factors which have the beginning of their existence early in the history of the life of the individual.

The continuity of consciousness and the sense of identity, which in its turn is dependent upon the continuous functional activity of the neurones concerned, seem to be in some way associated with the structural continuity of those elements.

When the development of the cerebral and spinal nerve masses is complete, the nerve-cells remain fixed in number and arrangement; this continuity of the constituent neurones is determined early in the developmental period and may have an important bearing in connection with the formation of combinations of mental processes occurring at a given moment with those which have been experienced at some previous time.*

To maintain that the above described reactive phenomena which mark the habits of life of the lower organism are identical with the more complex processes of the human mind would be unwarranted, but the analogy certainly seems quite apparent, and by such com-

* Nuclear division of nerve cells, cell construction, and even mitotic figures, have been observed after injuries and inflammatory process in the cortex of the cerebrum and cerebellum. In normal nervous tissue, in the adult, the production of *new nerve cells has not been demonstrated.*

parisons much is gained that is of value in the study of mental process in human beings.

Phenomena Purely Subjective.—In accordance with the laws which govern the activities of living things, external † stimuli operate upon the receptive portions of the organism, and give rise to excitations followed by reactions which in higher animals are reflex in character.

Thus far the physical organism and the mental organization respond to similar causal influences, but thus far only, for in the matter of mental activity, or those responses which are psychic in character, there is an additional element which does not enter into the purely physical process. This element takes into account the added fact that the action of external agents is brought to the attention of the organism, and the effects upon itself are noted by the organism. Physical reactions are concerned with the objects of experience, and the psychical reactions concern the experiencing subject.[4]

External stimuli acting upon the organism produce effects which apparently are accompanied by some modification in the nervous elements of the organism. What the change is which takes place no one is willing to attempt to state.‡ For convenience in expression we say that the neuronic modification is a sequence of "impressions made upon the sense organs and the sensory centres, and is accompanied by a state of consciousness," which implies something accomplished psychically with the products of sensory stimuli. A person in coma is in a condition termed "unconsciousness." If he recovers from that state he has no knowledge of stimuli applied to his sense organs during the period of unconsciousness. Pin pricks, bright lights and noises make no impression, because they do not penetrate the field of consciousness, and are not brought to the notice of the individual. An intact nerve ending, an intact sensory pathway, and even an intact sensory centre are obviously not sufficient in this condition to bring about a state of consciousness, on account of the absence of the necessary further disposition of sensory stimuli. Consciousness has been aptly termed "awareness" and means "the interconnection of psychical process at any one time" (Wundt). When such connections are broken, consciousness is interrupted and a state of unconsciousness exists.

Early Nervous and Mental Manifestations.—It has already been stated that the earliest nervous manifestations in the infant are the result of inborn reflexes, and are not accompanied by consciousness; that is to say, there is a period when, although stimuli are received, the infant gives no evidence that it is aware of the existence of anything external to itself; in fact, it does not seem to be conscious of the existence of itself. Conscious experiences begin in the infant after

† External to the nervous system.

‡ Alterations of states of consciousness are believed, in the light of modern viewpoints, to be dependent upon changes in neuromuscular activity. (Dunlap.)

the first month, but are of a changeable character, as is shown by the rapid change of mood.[4]

Many reflex movements are not coördinated at birth, and some of them not for a considerable period after birth. For example, although the infant's eyes turn towards the source of a light stimulus, they do not react in the same manner as in the adult. The movement of the eye-balls of the infant is a reflex act which the infant is unable to inhibit on account of the fact that the ocular movements are as yet not under control.

In the low-grade idiot whose mental development, if begun at all, ceases at an early date, the same kind of reaction is frequently seen, as is defective power to coördinate bodily movements.

In a state of advanced dementia the inhibitory as well as the voluntary influences over motor activity is removed, as is shown by the dominance of primitive reflexive acts. Thus, the grasping reflex so strong in early infancy returns with the advance in the dementing process. This, however, seems to be due to the removal of inhibition. Although the patient is unable to voluntarily take hold of an object, the grasping reflex may be stimulated by contact with the object, yet the hold can not be released until another reflex is set in motion and becomes dominant.

By virtue of an inborn potentiality the individual reacts mentally to sensory stimulation, by reason of the repeated action of stimuli upon sensory organs and the nervous apparatus, and as the result of the reactions to those stimuli, the infant "learns" to distinguish between itself and "things" which are external, and ultimately becomes aware that the *subjective self* is acted upon by an external "something." This awareness is dependent upon the activity of reflexes.

In a comparatively short time, as the result of variations in the character and intensity of the stimuli, many of the reflexive movements, including such complicated movements as sucking and grasping, become more pronounced, and soon present the appearance of being more than reflex acts, and are ordinarily spoken of as *conscious acts.*

Self-Consciousness and Personality.—It requires but a brief period of observation to lead one to the conclusion that for a time in the early life of every person consciousness of a "self" is lacking; in fact, the infant regards his own body at first as an object, then as an objective self, while the real concept of a subject self, the Ego or "I," is reserved for the conscious states of more mature mental life.

Assuming that in the early weeks the child does not distinguish the body or its various parts from objects of the external world, it seems clear that the organic sensations are fundamental and important components in the rise of a "feeling," which in turn leads the subject to distinguish between himself and the objects of the external world.

It may be said that the occasion for the development of the self arises out of the practical needs for a distinction between the individual and the outside world and between the individual and others (Pillsbury).

According to Höffding, "the general feeling which results from the state of the entire organism" is cœnesthesia. This feeling may be regarded as the resultant of the effects of organic sensations in their relation to the formation of the notion of self. Added to the feeling of self, as distinguished from other individuals and external objects, there arises an idea, which has for its basis visual and tactual percepts intimately connected with the body, and with a "feeling of unity" (Wundt) which constitutes the fundamental attribute of the conscious self, giving rise to the concept of an organized unit.

In the development of the self it is essential that the child should distinguish, first of all, the experience derived through the handling or contact with parts of his own body, from the experiences gained through contact of the body with external objects. In this way the child is given the opportunity for the rise of the idea of the objective or physical self. This idea is aided in its development by the percepts of other selves and the discrimination between one's self and other selves.

The subjective self seems to be less concerned with the body as such, but rather to experiences and the attitude of the individual towards those experiences, as if it were "a bodily self with the physical characteristics subtracted" (Pillsbury). The development of the subjective self is regarded as dependent wholly upon organic and kinesthetic sensations, and is the self which is "affected" by the external agents which are responsible for the individual's sensations, and constitute a passive self. Furthermore, the most important self, from the standpoint of the individual's activities, is the self which arises out of the feeling of effort, or strain, the feelings accompanying emotional experiences and volitional activities.

It may be concluded that the consciousness of self is not a fixed mental state, but is ever changing with the experiences of the subject. The "I" or "myself" may be at one time the most conspicuous concept in the field of consciousness, and at another time it may be almost absent.

The Ego or "I" is purely an abstract idea (concept) which arises out of an aggregate of feelings, leading to the awareness on the part of the subject that he is the individual affected by objects of sense, and that he is the subject of his activities.

The complex of organic and kinesthetic sensations, together with visual and tactual percepts of other individuals experiencing like sensations, to which is added a feeling of unity of organization and an idea of self as distinguished from others, forms the basis of the personality. The personality develops with the mental life of the individual and is dependent upon his experiences.

Mental Organization.—In the interconnection of mental processes psychic elements are made use of in various ways by a process of synthesis, in which the elements of mental experiences are correlated and arranged in groups. The earliest formed groups of mental experience are the simplest and become the most stable. For example, the simple sensorimotor reaction of the infant looking in the direction of a familiar sound is a much more stable reflex than many of the complex reactions acquired later in life.

In the following chapter the several mental components will be discussed as separate psychic "processes," but it should be understood that in practical experience no single mental process can be regarded as independent in its action. We are to begin with the simpler processes which can be considered only in the light of psychological abstractions, and from these to pass to the consideration of their compounds.

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CHAPTER V

PSYCHOLOGICAL PROCESSES

At the same time that the individual becomes aware of the effects of stimuli, that is to say, when a state of consciousness exists, he experiences additional subjective phenomena, which are included within the meaning of the term "mental." These subjective experiences are collectively known as "mental processes," and are to be distinguished from purely physical nervous (neuronic) phenomena.

Sensory Experience.—When the new-born makes its initial "acquaintance" with the external world, its first experience is gained by contact with the colder external atmosphere which stimulates the cutaneous nerve endings. The increase in CO_2 after interruption of the placental circulation also results in the stimulation of the respiratory centres in the central nervous system. This peripheral excitation is followed by a reaction which takes place through the nerve distribution to the peripheral blood-vessels, resulting in an increased blood supply to the viscera, in the same manner that a "chill" is produced. The whole reaction is a complex, resulting in an inspiration, an expiration, a cry, and breathing is established. In some instances, in which the initial stimulus is not sufficient for the excitation of the respiratory reflex, there is temporary asphyxiation which can only be combated by a peripheral irritation of unusual intensity, such as by slapping, or by pouring cold water or ether upon the surface of the thoracic integument. Thus the necessary peripheral stimulus is artificially supplied to produce the first post-natal sensory-motor experience which for some time continues as a pure reflex.

Sensory stimuli of taste and touch are also soon made evident, shown by the early appearance of the reactive movements of sucking; these are followed by auditory reactions and still later by visual reactions.

As has been stated in an earlier chapter (p. 72), in order that sensory stimuli may become effectual an intact sensory organ (receptor), such as the retina, organ of Corti, taste-bud, olfactory cell, tactile corpuscle or free nerve ending, is essential. Equally indispensable is an intact nerve pathway for the transmission of the effects of stimuli; and, to complete the functional unit, the receptive nerve centre must be intact. The receptive centre may be in the gray matter of the spinal cord, in one of the bulbar nuclei or basal ganglia, or in one of the "lower" centres in the cerebral cortex. Wherever located, these centres constitute the central receptive points, or if in the region of the cortex, are termed the sensory "areas," and collectively constitute the sensorium.

An individual born with a nervous apparatus so defective as to be deprived of these receptive organs, and thereby deprived of the means of receiving corresponding kinds of environmental stimuli, would obviously have no means of neural contact with the external world. Persons who from birth are deprived of two or more sense organs, or pathways, or centres, especially if the senses happen to be vision and hearing, are usually mentally defective, in so far that they lack both of these categories of experience.

The exceptional instances of Laura Bridgeman and Helen Kellar[1] are marvellous examples of the effect of intensive training combined with unusual ability. If these women had not been deprived of those sensory organs and nervous mechanisms (in Laura Bridgeman's case there was marked atrophy of the cuneus),[2] they doubtless would have developed brilliant mental ability without special training.

The individual with intact peripheral and central nervous mechanism is thus enabled to distinguish external " objects " from " self " after repeated contact with the external world (mediate experience), and through the repeated elaboration of simple mental processes (immediate experience) into mental compounds. The simplest mental elements can be examined in the abstract only, and are the " products " of analysis of composite mental experience.

Simple Sensation.—The simplest mental phenomenon, regarded as fundamental, elemental and unanalysable is the *simple sensation.* Sensations are mental elements which constitute the foundation upon which psychologic investigation is constructed, and furnish an equally important basis for the study of the symptoms of mental disorder.

These elementary mental phenomena for purpose of study are regarded as *separate from thought,* yet as essential factors in psychic activity; furthermore, sensations are considered as uncomplicated by any mental state other than that of consciousness of the effects of external stimuli.

What sensation is, psychology does not know, yet it is recognized as a mental process having some relation to an external reality manifested through the activity of the senses. Pure sensations cannot be experienced in such a way that they can be directly examined, yet psychologists do study sensations with regard to their attributes, as the chemist examines his physical elements of substances. It is impossible to isolate in mental experience a sensation of color, of sound, or of an odor, so that it stands alone in consciousness. Sensations are invariably associated in the mind with former sensations or experiences; they cannot be experienced singly for the reason that an attempt to think of a given sensation immediately causes the rise of the idea of some previous similar mental experience, and usually the idea of the object (thing) which produced the sensation.

The requisites for sensory experiences include a stimulus, normally received by a sense organ; the effect of this excitation is carried by a sensory pathway to a sensory centre, and finally the sensory centre must react to the nervous excitation.

The physical processes which give rise to sensations are of two kinds: (1) those which come from the outer world in the form of pure (external) **physical stimuli**; (2) those which originate in the bodily organs of the experiencing subject, in the form of **physiological stimuli.** Physiological stimuli are divisible into the *peripheral* and the *central,* according to the seat of origin of the stimulus, that is to say, whether in some non-nervous structure, or in the nervous substance. Experiments in animal behavior upon lower organisms indicate that nervous impulses are waves of chemical reaction which travel along the nerve fibres.[4]

The differences in the character of sensations experienced depend upon the differences in the kind of excitation which arises in the sense organs stimulated; the excitation is first determined by the kind of stimulus applied at the peripheral end organ. A sensation may be the accompaniment of a physical or of a physiological stimulus, that is to say, it may have its origin in an external physical stimulus, or in some viscus which gives rise to a peripheral stimulus, and in turn gives rise to a centrally aroused sensation. In all instances the central excitation is essential to the production of the sensation. Neither a physical nor a physiological stimulus can give rise to sensation without being connected with a central stimulus.[3]

Varieties of Sensation.—The kind of sensation which follows this series of events depends upon the type of sense organs at the seat of the excitation, and upon the central area in the brain thus stimulated to excitation. If the brain cortex be directly stimulated as by an electrical current locally applied, in a given sensory centre, a sensation is produced like that when the same centre is stimulated from the corresponding peripheral sense organ. Furthermore, in order that a sensory centre may be stimulated it is necessary that the centre shall have been accustomed * to responding to external stimuli. For example, a person born blind shows no evidence of experiencing light sensation when the cortical visual area is stimulated. This fact has been employed to corroborate the statement that the development of specialized functions is the accompaniment of external stimulation and in all probability is largely dependent upon it. If a physical stimulus be employed to excite the cerebral cortex in a given area, the same kind of sensation will follow irrespective of the nature of the stimulus whether mechanical, electrical, thermal, or chemical. Similar sensations which arise in some other structures, and in the viscera, result in the production of a number of sensations of complex character.

* The removal of cataracts from the eyes of a patient born blind does not enable him at once to see (perceive) the external world.

Subclasses of individual sensations have been made, but only in an unsatisfactory way. Of the sensations grouped under the term "special sensation," sensations of smell are the most difficult to classify. A classification of odors can only be provisional, as, for example, ethereal, aromatic, fragrant, empyreumatic, ambrosiac, nauseous, hircine (rank), virulent and foul.[5] Particular olfactory stimuli depend upon the chemical composition of the substance which stimulates the olfactory apparatus, hence these sensations belong to the group of "chemical sensations."

Taste sensations are closely related to sensations of smell, both physically and mentally. Taste disturbances commonly occur through affections of the nasal mucous membrane as the result of interference with the sense of smell. Some sensations commonly regarded as taste sensations are sensations of smell. It is difficult to distinguish the kinds of taste when the nostrils are closed so as to exclude smell sensations while eating and drinking. It is on account of the close functional relation of these two senses that smell sensations are frequently mistaken for taste. In mental disorders hallucinatory disturbances of these forms of sensation occur which are found to affect both smell and taste. The various kinds of taste are usually included under the "primary" taste sensations, bitter, sweet, acid and salty.

In the realm of *cutaneous sensation,* which includes sensations received by the skin proper and also by mucous membranes, several sense modifications are recognized. Objects may be said to feel hard or soft, smooth or rough, warm or cold, which are the usual sensations by which objects are recognized and described by the experiencing subject. In addition, there is mechanical sense, the pressure sense by which things are considered heavy or light, and the muscular sense which forms the afferent basis for the control of muscular movements, especially the synergistic action of muscles in voluntary effort, essential for all coördinate movement.

Auditory sensations are purely mechanical in origin, depending upon the transmission of wave-motion to the auditory apparatus of the basilar membrane (Fig. 56). Sounds are grouped in two classes, noises and tones, the latter being subdivided according to the character of sensation which accompanies them, into those of high and low pitch. Individuals vary greatly in the matter of sensitiveness to variations in pitch; in fact, the ability to differentiate pitch may differ in the two ears. On account of the intimate relation which exists between sound impressions and language, mental development receives considerable aid through this class of sensations. Persons born deaf are greatly handicapped mentally even when specially trained. Deaf-mutism and idiocy are frequently associated.

Visual sensations are usually spoken of in terms of various degrees of light sensation, and of the fundamental colors and their combinations or "shades." We recognize certain colors as being lighter or

darker, meaning that they approximate white or approximate black. Of the colors of the spectrum yellow is the lightest and violet is the darkest color. Mixtures of colors, as in the case with sounds, may appear as simple sensations. As also occurs with respect to sounds, the number of distinguishable colors varies greatly with different individuals. Visual and auditory sensations commonly act together or alternately as in the instance of spoken and written language. Persons born blind are able to make more progress mentally than those deprived of auditory sensations.

In comparing and contrasting sensations one with another, we are accustomed to acknowledge that sight and hearing are the "higher sensations"; these are so called because the experience derived through them is of a more definite character. Taste, touch and smell occupy a less important position in the matter of furnishing the individual with knowledge of the environment.

The mental elements called "simple sensations," which are derived through the sense organs, must be clearly distinguished from the mental processes by which objects or things are recognized as possessing those *qualities* which give rise to the sensory stimuli. These must be considered as attributes of objects, which attributes are really mental states produced at the instance of those external objects. Psychologically the odor of a blossom exists only when there is a sensory apparatus to receive the stimulus which initiates an activity resulting in the experience, the odor of the perfume; there really exists only a blossom capable of arousing the sensation in the experiencing individual. "Sensations are, primarily considered, the modes of our being affected—the objects of sense are the real things which are assumed to exist independently of the affection of our minds and have their inherent qualities disclosed to us through the operation of our senses."[6] If one sense is lacking in an individual, he is deprived of just so much experience, and being deprived of so much experience his idea of the external world will accordingly differ from that of the individual who possesses that sense (see Perception).

The Attributes of Sensation.—The attributes of sensation may be considered under four heads: (1) the quality or kind of sensation; (2) quantity or intensity of the sensation experienced; (3) the duration or length of time the experience exists; and (4) the extent of the sensory field over which the experience is projected.*

The quality of the sensation depends chiefly upon the particular kind of sense organ to which the stimulus is applied, and also the

*Sensations are not to be regarded as having their location in any peripheral ending, but rather as in the sensory areas of the cerebral cortex. In illustration as evidence may be offered the phenomenon known as reflex hallucinations, experienced by persons who describe sensations which they refer to amputated limbs. Destruction of the peripheral sense organ is not invariably followed by loss of the corresponding sensation. If, however, the cortex has been destroyed in a given sensory area, the corresponding category of sensation is lacking.

kind of stimulus which gives rise to the sensation. The kind of sensation always remains the same with stimulation of the same sensory area, whether the stimulus be by mechanical, electrical, chemical or thermal means. The quality of a sensation may remain the same while there may be a wide variation in other attributes of the same sensation. In the higher or more specialized sensations, especially vision and audition, there may be innumerable variations in quality. For example, the sensation red differs from that of blue, yet they are both forms of light sensation, and differ because of the difference in the wave-lengths of the light stimuli. In the same way musical tones differ, according to the rate of vibration of sound-waves. Taste and smell sensations differ in quality but to a more limited degree.

Quantity or intensity of sensation is the attribute which is described in terms of strength or weakness of sensation. The quantity of a sensation may vary greatly, yet the quality remains unchanged. The intensity of a smell, taste, visual or auditory sensation may vary and yet the sensation remains the same in kind or quality. An odor of violets may be more penetrating in an extract made from one supply of the blossom than that made from another; the light from one luminous body more powerful than another; the bitter of strychnin more intense than that of gentian, or of peach kernel; the sound of a single note more intense the moment it is sounded than later, although the quality of the note is unchanged.

Sensations are described as of long or short duration according to the period during which they are experienced. Some kinds of sensations are still appreciable after the stimulus has ceased to act, as, for example, after steadily looking at luminous objects the sensation of light continues if the eyes are closed. This phenomenon furnishes the basis of the so-called "after-images."

Experience shows that we are able to appreciate differences in quantity or intensity of sensation when we compare the effect of one stimulus with another stimulus acting upon the same sensory organ. We never think of comparing the effect of a stimulus acting upon one sensory apparatus with a sensation which results from the stimulation of another sensory organ, for example, it can not be said that one substance is as sweet as another is red.

Weber-Fechner Law.—It is possible to measure, within certain limits, the minimum amount of stimulus required to produce a given sensation. It is also possible to measure how much of a given stimulus is required to produce the greatest quantity of sensation. Relative changes in the intensity of stimulus give rise to relative changes in intensity of sensation. At first, when the stimuli are relatively weak, it requires but a slight increase in the amount of stimulus to bring about a noticeable increase in the intensity of the sensation. In a series of sensations of increasing intensity, the sensations of greater intensity require for their production still greater

degrees of intensity in stimulus; this ratio increases with a uniform progression. The law which expresses this relationship between changes in the intensity of stimuli and changes in intensity of the sensations experienced is known as Weber's Law, which was first shown to be applicable to the minimum noticeable differences in visual and pressure sensations. The same law was shown by the investigation of Fechner * to apply to sensations generally. It was found that the least noticeable difference in sensation is a constant quantity for all sensations of moderate intensity, irrespective of the nature of the stimulus, whether electrical, mechanical, chemical or thermal.

Sensations and Their Physiological Antecedents.—Sensation is regarded as the result of some modification of the nervous mechanism, and as dependent upon the action of some external agent or "thing," affecting the organism through the medium of the sensory apparatus.

Sensations have been classed in two large groups: (1) **special sensations,** which arise as the result of stimuli applied to the sensory organs. These organs constitute the receptive apparatus, all of which are of ectodermal origin, and are therefore in direct contact with the outer world; (2) the **organic sensations,** which arise as the result of the activities of the body structures, viscera, muscles, joints and other tissues.

All sensations are peripheral from the standpoint of their place of origin, with reference to the nervous system; but, from the standpoint of the soma one sensation may be said to be external, and another internal. From a psychic standpoint, however, no distinction is recognized between the mode of activity of the special sensations and that of the organic sensations.

The number of kinds of sensation is so large as to be practically beyond estimation, and the only practical means of their classification is based upon the corresponding organs through which the sensations are received. These, with their anatomical and physiological prototypes, have been discussed in an earlier chapter, as visual, auditory, olfactory, gustatory and tactile, including pressure, pain and temperature senses, muscular (kinesthetic) and static senses. The kinesthetic and static sensations arise through stimuli brought about by the activity of the muscular apparatus.

To summarize: sensation is regarded as the starting-point of mental development and forms the foundation of all mental functions. The experiencing subject distinguishes the products of sensation from one another largely because one sensation follows another, from which arises the possibility of the perception of time. The direction from which the sensations come to the individual is determined by the

* In order that the intensity of sensation may increase in an arithmetical progression, it is necessary for the intensity of stimulus to increase in geometric progression. If the sensation is to be increased from 1 to 2, the stimulus must rise from 10 to 100.

activity of space perceptive processes. Perception depends upon a complex of sensations in which some external agent is recognized as an entity and as the object of the sensory experience. Following upon sensation, affection, and attention, perception is made possible. By reason of memory processes, imagination and association and the accompanying emotional state, judgments are reached which may give rise to volitional acts.

All of these mental processes, normally evolved, are the more or less immediate modes of reaction to somatic and external physical stimuli, and constitute what we term in the aggregate the **mind.** In other words, "the sum total of experience dependent upon the nervous system," [7] expresses the conception of the term as here employed.

By reason of individuality, association and environment, during the process of mental evolution, the mind becomes so constituted as to give to the individual what is commonly spoken of as his mental characteristics. These are found not to be identical in any two individuals, so that there is no limit to the possible variations in mental characteristics.

Apperception.—According to followers of the Wundtian and Herbartian Schools of Psychologists, perception is not regarded as sufficient for bringing into the field of consciousness "the clear grasp of any psychical content." According to Wundt,[1] "The process through which any content is brought to clear comprehension we call apperception." This implies that just as pure sensations are not recognizable as such in actual mental experience, but are always united with sensations connected with past experience, so it is with pure perception, that is, something must be added to perception by a blending of the percept with the whole mental content.

The experience of looking for the first time in the field of the microscope, for the average student, is an experience of pure perception. The percept of the morphological arrangement of histological structural components has no meaning for the novice until made clear by comparison with some familiar percept, such as the idea of a mosaic or pavement, as commonly is used to explain the structure of an epithelial surface.

In order that percepts may be brought into clear comprehension, it is necessary that they be blended with former experiences (percepts). Apperception has been described as "more acute perception, rendered possible by more concentrated attention, and promising results of much greater advantage for the evolution of mind." [2]

This is another way of stating the fact of everyday experience, that the majority of our percepts are mixed. Furthermore, that they not only are composed of mixed sensations and perceptions, but are largely composed of images (ideas) of former percepts; and it may be said that "the life of perception is far more than one is apt to suppose—a life of imagination," [3] (*i.e.*, formation of mental images).

Some psychologists see no use for the term—apperception. James disposes of it by saying that inattentive awareness and attentive awareness are equivalents for perception and apperception.

Whatever explanation may be considered adequate for the psychologist, it is essential for applied psychology to recognize that something more than perception is necessary for the clear comprehension of a fact of experience.

For example, when looking at familiar objects at a distance, one is able to perceive the object correctly from the standpoint of its size. We can decide without difficulty whether we are looking at a man or a small boy at a distance, although the real visual image of the man is much smaller than it would be when he is standing near the observer. This is explained by the fact that as the result of former visual experiences one forms a definite idea of the average height of a man of normal size even when seen at a distance.

In the case of looking at an unfamiliar object at a distance one is entirely dependent upon the visual image; having had no prior experience, and therefore no mental image to correct the perception, the object appears much smaller than it really is.

Similarly familiar songs, quotations and poems, when spoken at a distance, are more clearly heard than would unfamiliar phrases uttered with the same degree of sound intensity and tonal quality. As a matter of fact all the words may not actually be heard, but the perception of a word or two spoken, by reason of association with ideas of the former experiences, suggests the remainder of the older percept which is recalled and blended with the immediately present percept.

The association of present experiences with the past may be so strongly suggestive of the former percepts as to produce an illusory effect, as in the example of the boxes of unequal size but equal weight (see Illusions, p. 153). Many of the illusions of the mentally disordered person are produced in this manner. It may be said that one's percepts are being constantly controlled, modified and influenced by ideas and percepts which happen to be present at the same time, and the process, by which the blending of former experiences with those of the present is accomplished, is termed apperception.

In order that the past experiences may enter into the composition of the total mental content it is essential that those experiences be mentally reproduced (see Memory Processes, p. 104).

Association—(Passive Apperception).—In the early studies of psychology, beginning with Aristotle and extending to the time of Hartley and Hume, the doctrine of the association of ideas was considered of great importance, especially by the followers of the latter school. Aristotle taught, for example, that as a means for stimulating memory, if a certain idea is wanted, one should begin with a similar idea or its opposite, or one spatially or temporally contiguous. This was the fundament of what later comprised the "association psychology."

which dealt chiefly with ideas as if they were processes of mind that could be repeated in consciousness. The law of association was compared with the law of gravitation, as a sort of "attraction" which brought together the ideas in the mental sphere in a similar way that, in the physical world, masses are brought together. In fact, several laws were formulated under the terms of similarity, contrast, simultaneity, and succession.

Recently the tendency has been to reduce the number of the bases for comparison, thereby reducing the number of laws to one basis of contiguity. "What really does happen in an act of memory is the rise of a new idea in consciousness; this new idea always differs from the earlier idea to which it is referred, and usually derives its elements from a number of preceding ideas." [3]

Although association is an important factor in an act of memory it must not be considered the same, as memory is but merely one of the mental processes concerned. The theory of association as now accepted, in explanation of the mental phenomena characterized by a grouping of mental experiences, may be stated thus: whenever a sensory process or its mental product enters the field of consciousness, there is a tendency for the mental experiences which occurred with it at some prior conscious period also to enter the field of consciousness. Such an arrangement of component ideas comprises the average flow of thought. True enough, the association may depend upon similarity or contiguity, either in regard to their occurrence in space or in time. For example, if one thinks of the seashore, there may arise in consciousness, and in imagery, the expanse of sandy beach, the expanse of sky and ocean, the waves and sea-gulls. Letting the train of thought go on, there may arise in imagery the persons met at the last visit, possibly some of the subjects discussed; a Sunday morning walk to church, the subject of the sermon preached, and so on. One thought, we say, brings up another. What really happens is, the rise of the image of one perceptual process furnishes a stimulus which of itself is sufficient, by a like mental process, to give rise to images of other past experiences similar to the first, or associated with it at the same time, which enter the field of consciousness with the succession of the various elements in the train of thought.

The association of ideas is an important psychologic factor in memory processes, and will receive further consideration in the discussion of that subject.

In some disordered mental states the apperceptive process is totally passive, being enforced by the rapid flow of ideas. The train of thought is made up of irrelevant ideas, one idea being called up by a preceding idea and its habitual association.

Attention—(Active Apperception).—According to Wundt, the state which accompanies the clear grasp of any psychical content is characterized by a special feeling which we call attention. One cannot

give attention to an experience without accentuating its clearness. This quality of an experience may vary from one of greatest intensity to comparative obscurity. Attention may, therefore, be said to be measurably related to sensory clearness. With the entrance and departure of mental experiences from the field of consciousness there occur certain physical phenomena which will be discussed under "affection." These physical concomitants are the commonly observed bodily movements with changes in the pulse and respiration rate, and certain visceral changes; these phenomena are likewise dependent upon the degree of attentiveness given to sensory experiences.

Attention also constitutes an **attitude,** or reaction, to an impression, and therefore implies *attraction* towards an object of sense or *repulsion* from it. With attention there arises an emotional attitude which may increase or diminish the degree of attentiveness, according to the attractive or repulsive nature of the reaction.

In many instances impressions may produce no reaction for the reason that attention is "fixed" upon another impression which arouses a stronger feeling of interest.

Attention may be said to be either *passive* or *active.* Passive attention is involuntary, and occurs as the necessary (uncontrolled) reaction to loud sounds, brilliant lights, intense pains, or any intensive stimulus; again, sudden changes of stimuli tend to bring about involuntary attention.

Active attention implies a mental effort, under which the products of sensation gain a position of clearness and hold the centre of consciousness. Furthermore, active attention is largely a matter of education and mental practice. Children and the feeble-minded are notably lacking in attentive power; the content of consciousness in children is largely dependent upon accidental experiences, while in adults, through training, attention is given to certain sensory experiences while others may be disregarded, even though they may be of greater intensity.

When reproduced ideas enter the field of consciousness and occupy a position of sufficient importance in relation to a definite idea or train of thought, and hold the centre of the field of consciousness in active attention, the mental process involved constitutes *active apperception.* Only those ideas to which attention is given enter into the realm of apperception.

Studies with reference to attention have led to the conclusion that the stream of consciousness flows in two levels, one the higher and clearer, the other lower and more obscure. Clearness is the chief characteristic of mental experiences of the higher level of consciousness; these experiences are processes that have been brought into activity by the favoring or inhibiting influences of attention (Tichener).

One may be vaguely conscious of an occurrence and yet may not obtain a clear apprehension of it, for the reason that active attention

is given to something else at the moment. The fact that one is conscious of a given experience implies that it has become the **object** of attention at that moment. The matter of attentive power resolves itself largely into a two-fold mental effort; one which depends upon the ease with which facts of experience are held within the field of consciousness; the other, an inhibitory process, by which certain experiences are excluded. Some psychologists explain attention purely upon a basis of inhibition; that is to say, that we give attention to certain experiences only by excluding all others from consciousness. Both means of "fixing" the attention are explainable on a basis of the *attitude* assumed by the experiencing subject. Bianchi supports this view of the matter when he says "Attention is a reflex phenomenon in response to a stimulus acting on the senses." [14]

The Moment Consciousness.—The particular content of thought which occupies the field of consciousness at a given moment is termed the "moment consciousness," and comprises the mental components related to that subject of thought. If, for example, one is occupied in considering a certain problem, the attention may be abruptly diverted and the centre of thought shifted to another subject of past experience. This is made possible by that fact that on the outskirts of the field of consciousness other groups of mental experiences exist, which may at any time be taken up and occupy the central part of the field. In every instance the present experiences form themselves into a moment consciousness made up of "psychic material synthetized round one inmost central event which in its turn may have a central point." [8] If one is studying the nervous apparatus of the star-fish, the attention may suddenly be drawn from the interest of the morphologic problem to that of a visit to the seashore, together with the images of the ocean, sky, gulls, and other objects of experience. The centre of the moment consciousness is occupied by the most important experience at a given time. Mental synthesis is essential to the construction of the moment consciousness, and includes not only psychic states experienced in the present but also those of the past.

The relationship of the star-fish to the visit to the sea may be clear at a glance; some other similar diversion of the train of thought and shifting of the centre of the moment consciousness may not be so easily explained, yet without doubt is in some way related. The realization of the ease with which a central topic of conversation may be changed almost without one being aware of it requires but a moment of reflection. Among children and the illiterate this tendency to distraction is more marked than among persons with better-trained minds.

In abnormal mental states, particularly those of exaltation, the train of thought is broken into "moments consciousness," which appear to be connected, as will be described under "flight of ideas."

Genesis of Movement.—Every sensory impulse received by a peripheral organ is carried to a sensory centre, and transformed some-

where into a motor reaction, provided the stimulus is sufficient. The mental and physical effects of hearing the sudden fall of a heavy object in the next room, or a pistol report out-of-doors, constitute the reaction on the part of the one who hears it. The effect is "startling," in that it causes a motor reaction affecting the entire body. The same **tendency to motor reaction** accompanies every sensation, feeling and emotion, but only becomes manifest externally when the intensity of stimulus is sufficient. There are great individual differences in the external manifestations of emotion; some persons jump at the slightest unexpected noise; some emotional reactions are accompanied by much more marked external manifestations than others. The motor reaction may be said to be in direct relationship to the emotional states which accompany the sensory experiences and to the attention given to them.

The translation of sensory experiences into motor reactions requires time. The period which elapses between the application of the stimulus and the motor reaction is expressed in terms of psycho-physical time. A stimulus such as of light, sound or an electrical cutaneous stimulation may be used for the determination of the **reaction time** of the person to be examined. By means of a mechanical device a record is made at the moment of the application of the stimulus and again at the moment of the reaction. The person examined is told to remove his finger from the key of a telegraph instrument the instant he sees a flash of light, the interval being recorded upon an appropriate apparatus.

The motor effect of a stimulus, as already stated, may be noted as a reaction of the entire muscular apparatus, as when one is startled, or it may be shown in a movement of a particular group of muscles, as of the muscles of facial expression, with or without speech. Not only the skeletal muscles are concerned, but also the musculature of the heart, blood-vessels and viscera. The first effect of an emotional shock upon the heart action is that of momentary inhibition, which is promptly followed by accelerated activity. The respiratory rate is also changed; the breath at first held and then quickened; finally respiration is prolonged in a sigh, when the crisis is passed.

The visceral reactions to such "shock" stimuli are facts of common observation. The dryness of the mouth associated with fear, the lachrymal secretion in both sorrow and joy, the dilatation of the pupils both in fear and anger, and the moist skin and goose-flesh are familiar examples. Involuntary micturition is frequently seen in frightened animals, and also a diarrhœa of fear is not infrequent as a visceral reaction.

The motor results of sensory impressions and their mental products have been classed under the following heads:

1. Pure reflex acts—automatic acts.
2. Instinctive or impulsive movements.
3. Emotional acts or expressions.
4. Voluntary acts.

Practically every form of movement has a reflex element in its composition, in the sense that it is a reaction either directly or indirectly to a sensory stimulus, and is possessed of a sensory and motor component. This importance of the reflexive element varies from the simple pure reflex acts, in which no other element enters, to that of the highest type of complex volitional act in which the reflex is simply of initiative importance.

Reflex Activity.—The earliest responses to sensory stimuli we have stated elsewhere (p. 73) are reflex and are dependent upon the functional activity of the "lower" centres. Many of the motor responses in adult life are also purely reflex, as in the pupillary contractions. From the psychic standpoint the important fact in connection with reflex movement is that in no way does it depend upon mental processes for its initiation. On the other hand, reflex processes may initiate volitional acts, may be interrupted by a volitional act, or may terminate in an act of will. Thus the iris reflex may be accompanied by a willed effort at visual accommodation; the knee reflex may be inhibited by the willed contraction of the hamstring muscles. The vesical reflex which in early childhood acts independently of conscious or willed effort is later both inhibited and initiated by voluntary effort.

Automatic Action.—This form of motor activity differs from the reflex action in that it has "degenerated" from the realm of volitional activity and through frequent repetition has become an act which can be carried out without conscious effort. It is this class of acts that constitutes our so-called **habits.** Many of the volitional acts of early life are later transformed into automatic acts, as in the case of the commonly cited examples of walking, piano-playing, bicycle-riding, and many acts of skilled motility. These acts are carried out without attention being given them, or at least without the concentrated attention and conscious effort such as were necessary when the person was "learning" to perform those acts.

Instinctive and Impulsive Movements.—It has been repeatedly emphasized in these pages that the contact of living organisms with environmental stimuli gives rise to reactions on the part of the organisms, and that, on the whole, these reactions are adaptive. The simplest reactions are termed tropisms; those that are somewhat more complex are considered as reflex. The reactions which follow sensory stimuli, as in an ordinary voluntary act, possess certain features that do not differ from either the reflex or the automatic movements, constituting the two lower types of action. All are *re*actions, whether the movement has or has not any representation in consciousness.

Instinctive activity usually implies that acts are carried out to accomplish a given end, without any previous knowledge of the result, and without any training with reference to the act.[4] Instincts are all regarded as complex reflexes which have appeared along with the development of the animal, as the species have arisen, and have served

as a means of adaptation to environment. If simple, as in turning to or away from the light (heliotropism), they are termed tropisms; if more complex, as in higher animals, they are termed instincts.[9] The acts of most animals classed among the lower vertebrates, including birds, are purely instinctive. For example, the definite manner in which animals respond to certain stimuli, such as the building of webs, combs, and hillocks by insects, the collection of suitable materials and the building of nests by birds after the fertilization of the eggs about to be laid, and the sitting upon the eggs during the incubation period. These are acts which seem to be methods of adjustment common to all members of certain classes of animals, and are connected with supplying certain needs, either for obtaining food, for reproduction, or for defence. Instinctive reactions depend for their character upon the organization of the structures and functions peculiar to the individual and are inherited. Many are protective, as, for example, the feigning of death reaction in time of danger.

Instincts, however, do not belong to animals alone. Man is said to have all the instinctive impulses possessed by animals, and also a great many others. If these impulses do not appear in the response to appropriate and specific stimuli, it is often due to the fact that other impulses arise which neutralize the first. Every instinct can be regarded as an impulsive act which has its origin in sense stimuli, either external or internal, or, as is usually the case, from both of these sources.

The list of instincts in man is a long one and cannot be sharply delimited from acts which have a higher psychic value. Sneezing, coughing, swallowing, reaching for food, are found in man and other animals alike. In advanced states of mental enfeeblement, especially the impulse of reaching for food is retained. If the hands cannot be used, as in general paralytic states, the impulse to grasp is made evident by movements of the head and lips towards any object brought near to the mouth, provided a visual sensation is aroused at the same time.

The more complex instincts possessed by man include curiosity, pugnacity, self-assertion, and others. These are said to appear and disappear at more or less definite periods in the life-time of the individual.

In the realm of *abnormal impulses* are found motor reactions that are exaggerations of those which fundamentally belong to the instinctive group. The fear of high places and the accompanying sickening sensation, together with the impulse to jump; the fear to cross a street; the miserly propensity, and the impulse to steal, are familiar examples. Among the "higher" instincts may be mentioned cleanliness, modesty, parental love; these, like the simpler types, are all directed toward the welfare of the individual and his kind, and are combinations of habit and instinct.

The simplest instinctive movements are the earliest developed; some are present at birth, as, for example, sucking, crying, grasping, and others. In early childhood are seen rebelliousness, pugnacity and destructiveness; at puberty appear modesty and the sexual instinct; later, is seen parental love.

All of these are the outcome of sensory impulses and, as we shall point out shortly, the emotional accompaniments of sensation, from which instincts cannot be separated in many instances. For example, fear and jealousy are similarly aroused.

Volitional Movements.—It has been shown that every sensation, feeling, and emotion tends to produce a motor act. From the broadest standpoint, action may be classified under two heads: *conscious activity* and *unconscious activity*. There is considerable reason for concluding that many of the acts of men and animals which we know to be largely unconscious have degenerated from acts which at one time were conscious.[10] Even those acts which we ordinarily term reflex, and which in our own experience never were within the pale of consciousness, that is to say, the physiologically involuntary acts, are believed by some to have been represented in ancestral forms by conscious acts.

Many of the complex movements, which we learn to make with great effort, become in time more easy of execution, and largely, if not entirely, unconscious movements. The acts of learning to walk and talk, which are accomplished with marked conscious effort and which are changed to acts in unconscious activity, are two of the best and most familiar illustrations. It is difficult to sharply separate volitional from non-volitional acts except from a psychological point of view, for the very reason that many volitional acts degenerate into mechanical, and the same act may be performed by the individual, under different circumstances, as either a conscious or unconscious act.

It will be understood here that pure volitional acts have representations in consciousness. All feelings are made up of affective processes which may be so related as to form a single but more complex affective state which we have termed emotion or the emotional tone. If this affective state ends as such, by gradually fading out, without any further result, the product is a pure emotion in the strictest sense.[3]

In practical mental life, however, it may be said that emotions pure and simple do not actually rise and terminate as emotions without some additional mental state following them, which in turn brings the emotional state to an end in some form of movement. The simplest examples are pantomime movements and movements of expression, such as accompany emotional states of joy, sorrow and anger.

"A volition entirely without an emotion . . . is a psychologic impossibility."[3]

Volitional acts are of two kinds: simple and complex. When a single emotion and the accompanying mental state bring about an

external movement, it becomes a **simple volition,** which corresponds to that type of movement termed an **impulsive act.**

Complex volitional acts arise when several feelings and ideas are experienced simultaneously; if these experiences are at all antagonistic, there must be a selection or choice of action, and the result is termed a **voluntary act,** in contradistinction to the impulsive act, in which there is no choice of action. With the entrance of the element of choice or decision into the process resulting in a volitional act, we say that the act is **willed.** This implies that conscious attention is a necessary factor. Many actions which under ordinary circumstances are termed voluntary, are not entirely so, inasmuch as they may be partly reflex, partly impulsive and partly voluntary.

Willed action depends primarily upon the concentration of attention, in association with an idea of a movement once carried out. The concentration of the attention upon that idea constitutes the fundamental mental act of will. Furthermore, this act of concentration of attention gives rise to a feeling of effort on the part of the subject, which feeling depends for its character upon the entire mental content.

The above implies that an act of will requires for its execution: (1) the possession of an educated reflex motor mechanism under the control of centres connected with the operations which condition the states of consciousness or the phenomena connected with them; (2) an attitude or emotional tone which tends to the concentration of the attention towards certain bodily conditions; (3) ideas of bodily states or activities such as have, through experiences, known relations to the conscious feelings of the experiencing subject; (4) a central mechanism in which the acts of concentrated attention and the discharge of the necessary motor impulse to the periphery are brought into relation one with the other.

Affection and Attitude.—It has been indicated (page 58) that some impressions are selected for response by the experiencing subject while other impressions may give rise to minor or no responses. It is this selective character of responses which is peculiarly associated with conscious processes in their relation to sensory impressions. Each impression is or is not given attention at the moment of experiencing it. Furthermore, in addition to the mental effort of selecting an impression for response, the motor response constitutes the external manifestation of the individual's experience, already noted in terms of sensation. The reaction invariably will be found to concern the welfare of the experiencing subject.

Every sensation is accompanied by mental states which are described under the convenient term "feeling," * which, to avoid confusion, is used in a definite sense, and is regarded as distinct from sensation. Whether regarded as an elementary affective process, or as an attribute of sensation, it is generally conceded that there are fundamentally only

* Affective States.

two categories of affection or feeling, namely, *pleasant* and *unpleasant*. The sensation of the green of a well-kept lawn is pleasant, while that of a strong light may be painful, yet both are light sensations; sound vibrations of definite rate and rhythm produce a tone which is pleasant, while those of a noise are unpleasant.

Affection is similar to sensation in that it possesses the same attributes; namely, quality, intensity and duration. Affection or feeling differs from sensation in that the former lacks the attribute of clearness. For example, one can give attention to a sensation or its product perception, but as soon as an attempt is made to fix the attention on an affection its qualities fade. In order that one may gain the pleasurable experience from a musical performance it is necessary to give attention to the auditory perception, but as soon as one tries to attend to the pleasurable experience itself he finds that it is no longer present.

The experiences ordinarily called "feeling," which are referred to the bodily sensations, such as hunger and fatigue, are organic sensations.

During waking hours, under normal conditions, organic sensations are constantly present. There is a tendency for all such sensations to become blended into composite sensations which, when associated with other sensations and perceptions, play a large part in the establishment of the conscious "personality" (see Self-consciousness, p. 73, *et seq.*).

Some regard as an important characteristic of affection the fact that its qualities are such that more than one affective state cannot exist in consciousness at the same time. One cannot experience pleasure and displeasure at the same *moment* of consciousness.

Strictly speaking, there is no sharp line of demarcation between feeling and emotion. The latter name is used because of the notable fact that every sensation and its accompanying feeling tend to end in a motor response on the part of the subject. All feelings, provided they continue in sufficient intensity, enter into the composition of emotions, and are always such as give rise to the expressions of pleasure or pain, comfort or discomfort. According to Judd,[11] the aspect of experience which corresponds to the "affective states" of other psychologists is the "attitude," which is considered related not to sensation but as a phase of **behavior.**

The first viewpoint considers the sensation as giving rise to a pleasant or unpleasant affective state; the behavioristic viewpoint regards the sensation as giving rise to attitudes of liking and disliking, the former viewpoint considering the objective, and the latter the subjective experience.

That the emotions are **adaptive reactions** is indicated by the fact that pleasant experiences attract the organisms to the object of sense, while unpleasant experiences are repellent.

According to the viewpoint of the physiologic psychologist, mental experiences alone are not sufficient to account for emotional states. The question of whether emotions are primarily physical or mental has

long been the subject of debate.[9] This question has arisen out of the fact that every emotional state is accompanied by certain physical changes on the part of the organism, which fact has led to the assumption that emotions have a physiological foundation. Visceral changes, such as accompany the emotional state commonly termed fear, are the usual physical concomitants, considered fundamentally as reflex, and therefore as dependent upon sensations, which in turn affect the organism as a whole. Among these reflex visceral manifestations may be mentioned the increase in rate of respiration, the dilatation of the blood-vessels and the increased pulse rate. The resultant *general feeling,* concomitant with these visceral changes, is the feeling to which we give the name **emotion.** Fundamentally, emotion may be regarded as the tone of feeling which accompanies a group of psychical states.

It has been long since found that it is well-nigh impossible to make a satisfactory classification of the emotions. For the purpose of this description, to mention some of the classes will serve to emphasize the essentially antagonistic character of any categories in which emotions may be arranged. Like the feelings out of which the emotions arise, the fundamental element in their quality refers to the welfare of the individual. Emotions have been classed as sad or joyous, sthenic or asthenic, natural or acquired, direct or reflective, and so on, almost indefinitely, according to the varieties of feeling to which the human organism may be subjected.

It is important, however, to note that emotional states are accompanied by, or terminate in, motor reactions. This motor component gives external evidence of the existence of the emotional state. In addition to the activity of the involuntary musculature which gives rise to the accompanying respiratory, circulatory and visceral (glandular) changes, activities arise in the skeletal muscles which furnish the basis of the bodily "expression" of the emotions. The movement of the muscles of facial expression and various changes in bodily attitudes are among the most prominent. Darwin, in his work on the "The Expression of Emotion in Man and Animals," has furnished most of the stimulus to classification of the various types of expression of the emotions. According to Darwin the changes in bodily attitude are traceable to "ancestral" instinctive reactions, although the original movements have largely disappeared.

These evident reactions are shown in the movements of facial expression and the states of muscular tension seen in the "bracing" and "shrinking" attitudes, which accompany such emotions as fear, anger, joy, sorrow, disdain and suspicion. For example, the well-known movements of the muscles about the nose and mouth, in response to ideas conveying a feeling of disgust or its opposite, are remnants of similar reactions which accompany repugnant taste and smell sensations; the nodding of assent is similar to the movements of the head associated with taking food; the lateral shaking movement of the head

indicating a negative attitude is regarded as similar to the reaction seen in the infant at the time of rejecting food; the "sneer of disdain" is the equivalent of the showing of the canine teeth by the angry dog.[9]

Some of the physical concomitants of the emotional reactions are regarded as useful or adaptive reactions. The reddening of the face and neck in anger is a means of relieving the brain of the blood-pressure incident to the increased heart action, and the flow of tears is considered as a similar depleting process.

The Adrenals and Emotional Changes.—It has been shown by Cannon [12] and his co-workers that the visible signs of marked emotional disturbances are due to the action of the sympathetic nervous apparatus upon the viscera. By experimentation with laboratory animals it was shown that blood taken from veins near the adrenal vein, after the animal had been kept for a time in a state of excitement, contained adrenin in quantities which could not be demonstrated in the blood of the same animal before the period of excitation. This was demonstrated by the application of the method of Magnus, by which, on account of the sensitivity of strips of living intestinal muscle to the action of adrenin, the latter can be detected in dilutions as high as 1 :20,000,000, by the inhibition of the characteristic rhythmic contraction of the muscle. This result could not be obtained in excited animals after the adrenals were extirpated. Similar results were obtained after the application of painful stimuli. It also has been shown that in pain and in great emotional excitement there is an increase in the sugar content of the blood, as a result of which the conclusion was reached that this also is the result of the increase in the amount of adrenin, and that it is responsible for the glycosuria found in man under marked emotional states. Cannon examined the urine of twenty-five members of a Harvard football squad and found that after an exciting contest, glycosuria was present in twelve of the number, and that of the twelve there were five who took no active part in the game, but were expectant substitutes. Similar studies were made of the urine of students before and after scholastic examinations, with the result that in one group 18 per cent., and in another 17 per cent., showed glycosuria, which was regarded as due to the emotional excitement.

Furthermore, the increase in the amount of adrenin in the blood favors the tendency to clot formation; in Cannon's studies this was shown to correspond with the facts connected with his other experiments; namely, that the coagulation time of the blood is shortened by splanchnic stimulation, resulting in pain, fear and rage.

On account of the fact that it can be shown that adrenin affects muscle in such a way as to counteract the effects of fatigue, the above results appear to indicate the defensive importance of the adrenals, in that muscles are prepared for greater or prolonged activity.

From the data obtained it has been concluded that all the body reactions accompanying the emotional states are **useful reactions.** In

animals and primitive man these reactions are regarded as apt to be accompanied by muscular violence for defence in the form of either fighting or running, preparatory to which these bodily changes occur. The increase in adrenin and the sugar increase are favorable to greater circulatory and muscular activity, necessary for the increased bodily activity, while the hastening of the clotting of the blood is a condition which prepares for the emergency in case of bodily injury.

Interrelation of Emotional Reactions.—That the emotions are interrelated has been long recognized by psychologists, and more recently physiologic studies have brought forth considerable evidence to strengthen the doctrine of the interrelation of the physiological components of emotional reactions. The milder emotions which accompany sensations of sight, taste and smell, associated with the experience of taking food, which are the so-called pleasurable emotions, enter into relation with the constructive side of metabolic activity, and are essential for the supply of the store of bodily energy. These emotional reactions associated with the vegetative functions are useful or adaptive reactions which are controlled by the bulbar (cerebral) autonomic nervous mechanism.

Cannon has shown the antagonistic character of the action of the sympathetic to that of the bulbar autonomic group of nerves. He developed the fact that emotional reactions accompanying stimulation of the bulbar autonomic nerves are diminished and sometimes abolished in the presence of emotions which arise in company with activity of the sympathetic. Examples of this occur in the inhibition of the activity of the digestive organs, the absence of the salivary, gastric, pancreatic and biliary secretions during strong emotional reactions. Again, such inhibition is regarded, from the physiologic standpoint, as an adaptive reaction by which the blood required for energizing the muscular and circulatory organs is diverted from the digestive apparatus to meet the emergency. A similar functional antagonism appears to exist between the sympathetic and the sacral autonomic, shown by the fact that the sexual emotions can not be aroused during a state of fear or anger, and *vice versa*. Cannon concludes that "the visceral changes contribute to an emotional complex more or less definite, but still pertinent, feeling of disturbance in the organs of which we are usually not conscious."

Emotional States as Attitudes.—Considered from the standpoint of behavior, and also the welfare of the individual, reactions of all organisms fall naturally into two opposing categories: the lowest organisms are attracted to external agents beneficial to themselves and are repelled from those that are harmful.

The same may be said for the "fundamental attitudes," pleasure and displeasure. These may involve the lower reactions, such as are concerned with the taking of food and, therefore, important in that

normal gratification is affected through activities occurring in response to taste and smell stimuli.

Perception—(Sense Perception).—The mental phenomena thus far considered under the terms sensation, affection and attention concern the individual and his awareness of being affected by an external something, but the nature of the exciting "thing," or source of the stimulus, is not revealed to the experiencing subject by any of these elemental processes. It will be recalled that practically a pure sensation does not mentally exist in adult experience; furthermore, that any attempt to mentally isolate a simple sensation results in recalling other sensory experiences, or, as is more often the case, an image (idea) of the "thing" originally giving rise to the sensation.

The psychic elements into which all psychical compounds may be reduced are two: sensations and simple feelings.[3] Some hold that there is but one mental element, namely, sensation. These serve only to give rise, in the experiencing individual, to particular modes of affection, and do not furnish any notion of the nature of the agent which is apparently responsible for the sensation or feeling.

The apprehension of material "things" arises by a mental process through which objects of sense are **presented.** It is in this manner that the individual is made conscious of the facts concerning the things which have given rise to the sensory experiences. Qualities *like* the mental experiences are mentally referred to external things.

In this mental process there is a "fusion" of a group of sensations and a recognition of the group as belonging together and different from the rest of the world (Judd).

That psychical compound of mental processes, by which are furnished mental data referring to material things made present to the senses, is termed **perception,** and although regarded as analyzable into elemental components, it cannot be considered a mere compound of sensation. Most perceptions are "mixed," that is, they are complexes of sensations and images (ideas) of previous experiences.

Just as sensation is regarded as simply a mode of affection from the standpoint of the subject, so must perception be regarded as a mental process by which sensations are referred to physical processes both within and external to the soma, and by which there is attained the consciousness of additional data concerning external objects of sensation. Furthermore, just as sensations must be regarded as phenomena restricted to that which is called "mind," so must psychical compounds of those sensations with former mental experiences be regarded as the mental phenomena through which knowledge of the external world is gained.

Having for a foundation such a synthesis of simple mental functions the resulting perceptions combine to form compounds which possess new characteristics. According to Ladd,[6] "The one characteristic which the presentations of senses possess, but which does not belong to

simple sensations that are their factors, is 'space form'." The sensations that were, now become extended in space and have definite relationship with other sense presentations or objects of sense. For example, perceptions of color, or of magnitude when complete, are no longer regarded merely as modes of affection of the individual by external objects, but are considered as qualities of objects. Upon this basis arises the assumption of the parallelism said to exist between the physical and mental processes; that is to say, " simply two aspects of the same world of experience."

Mental processes do not take place without corresponding physical or neural processes, although neural processes do exist independently of mental processes. The image on the retina is a necessary physical condition for the clear vision of outside objects, but, as Ladd expresses it, " it never becomes a kind of inner object for one's own mind. There is no image transmitted in exact copy from the retina by the optic nerve to its central nerve fibres and nerve-cells; if there were such a brain image we should need another eye connected with a second brain to see it." [6] In what manner this difference in quality between sensation and perception is affected, and in what way it becomes marked by the characteristics " space form," psychology is as yet unwilling to state, except to say that it is a process belonging within the domain of mind; that is, a mental achievement.

It may now be assumed that sensory processes are necessary for the perception of things; sensations alone, however, are not sufficient. According to some observers (Bianchi, Bourdon, Münsterberg), a motor element is necessary for the complete perception of things, especially with reference to space, distance, and the formation of visual images. For example, in looking at an unfamiliar object with one eye closed the picture formed is incomplete, unless there is a movement of the head to take the place of the usual movement of the eyeballs.

Perception depends partly upon present sensory experiences and partly upon past experiences with which the former are associated and become fused. In this way perceptions of things become more complex as the sensory experiences are multiplied.[14] The percept of an orange formed by an infant when the object is seen for the first time is not the same percept experienced after the infant has seen and felt it, or after having seen, felt and smelled it, and finally after having tasted it. With the addition of each sensory element the infant is provided with new mental data relative to the object of sense and the perception of the same object becomes more complex. Later the orange may be recognized through the activity of any one of the senses mentioned, together with the memory of the other former sensory experiences (see Apperception). Apperception contributes to the mental " construct " which is termed a perception. (Fig. 57.)

When stimuli are of such feeble intensity that they do not enter the realm of consciousness they are said not to cross the " threshold "

of consciousness. The attribute duration also acts directly as a factor in the production of perfect or imperfect perception. In a degree the repetition of a stimulus acts favorably upon perception, and up to a certain point perception is thus rendered more facile.

The point of view of the scientific observer of the external world is graphically described by Karl Pearson,[13] who says: "We are accustomed to speak of the 'external world,' of the 'reality' outside us." We speak of individual objects having an existence independent of our own. The store of past sense-impressions, our thoughts and memories, although most probably they have besides their psychical element a close

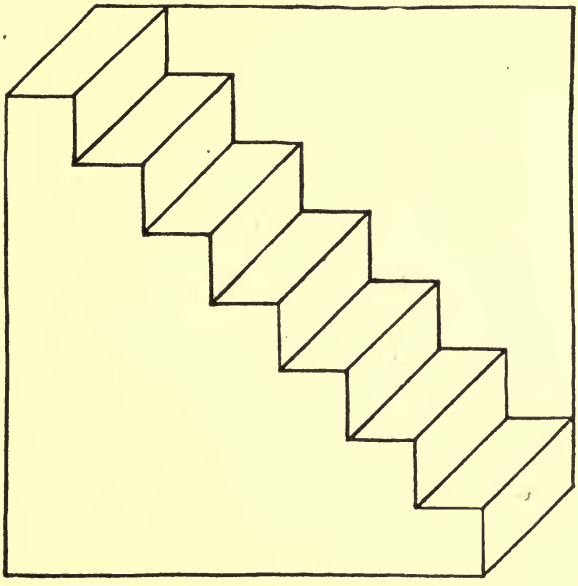

FIG. 57.—Schröder's Staircase Figure. (*After Witmer.*) "Does this appear as simple lines on the surface of the book? If so the resulting mental content is dependent on the visual sensation and the resulting percept. If the diagram appears as a staircase, which is the more likely mental experience, the mental content which arises is achieved through the process of apperception."

correspondence with some physical change or impress in the brain, are yet spoken of as **inside** ourselves. On the other hand, although if a sensory nerve be divided anywhere short of the brain we lose the corresponding class of sense-impressions, we yet speak of many sense-impressions, such as form and texture, as existing outside ourselves. How close, then, can we actually get to this supposed world outside ourselves? Just as near as but no nearer than the brain terminals of the sensory nerves. We are like the clerk in the central telephone exchange who cannot get nearer to his customers than his end of the telephone wires. We are, indeed, worse off than the clerk, for to carry out the analogy properly we must suppose him never to have been outside the telephone exchange, never to have seen a customer or anyone like a customer

—in short, never, except through the telephone wire, to have come in contact with the outside universe. "Very much in the position of such a telephone clerk," Pearson concludes, "is the conscious **ego** of each one of us seated at the brain terminals of the sensory nerve. Not one step nearer than those terminals can the ego get to the 'outer world,' and what in and for themselves are the subscribers to its nerve exchange it has no means of ascertaining. Messages in the form of sense impressions come flowing in from that 'outside world,' and these we analyze, classify, store up, and reason about. But of the nature of 'things-in-themselves,' of what may exist at the other end of our system of telephone wires, we know nothing at all."

Space Perception.—The "spread-out" quality belongs to the perceptions which, derived through visual and cutaneous sensations, furnish ideas of area, and, therefore, are said to occupy breadth and length. That spread-out quality cannot be produced to the same degree by sensations of smell or of sound. Visual and cutaneous sensations are in some manner possessed of a fixed and orderly arrangement so as to correspond with the external stimuli. Just how this is accomplished, no one is willing to attempt to explain, although it has been suggested that it is the result of repeated experience and habit.[7]

Space perception, then, is to be considered as either tactual or visual, and through its agency stimuli are promptly localized in space. The fact that the infant in the early weeks of its life has not acquired the ability to form space percepts, is clearly shown in its attempts to take hold of objects at a distance and out of reach; the ability to measure distance is yet lacking. The sense of touch is a factor in controlling ideas of location derived through visual stimuli.

The mental aspect of space perception can be demonstrated more easily than it can be explained. In the first place, taking visual percepts as an example, retinal stimuli are not referred by the experiencing subject to some part of the organ of vision, but, on the contrary, to some part of the subject's environment. A luminous spot emanates light rays which affect the retina, but the mental effect is that the light rays come from an external point. This fact has given rise to the expression that "sensations are projected" to the outer world, that is, when sensations are associated with their corresponding objects of sense. According to this doctrine, each individual's world is a "construct" arising out of sense impressions of the present moment, combined with the affect of former sense impressions that have left some trace upon the nervous mechanism.

To return to the subject of visual sensations and the construction of visual percepts, the visual images produced upon the two retinas are not precisely identical, neither do the images fall upon *exactly* corresponding retinal points in the two eyes. Nevertheless, the two retinas function as a single organ, and the two visual images are in some way united.[15] This phenomenon is regarded as responsible for

the existence of the three-dimensional vision and the stereoscopic effect by which objects in space are seen as solids. There is a strong tendency to unite in one visual image, images of two different objects, one thrown on the fovea of each retina. For example, when on one retina an image is formed of vertical lines and on the other one of horizontal lines, we see first one set of lines and then the other, never both sets at the same time, or part of one and part of the other; this is termed the "struggle of the visual fields."

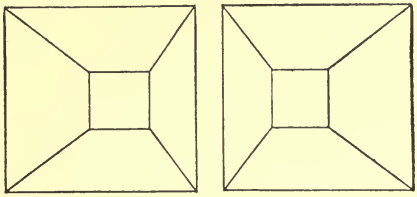

FIG. 58.—Right- and left-eyed images of truncated pyramid. These may be seen combined to produce a solid image if viewed with relaxed accommodation; that is, if looking at a distance through the book. (*After Howell.*)

A similar experiment, but more strikingly illustrated, may be carried out by throwing different colors on the two retinas. If we draw the image of an object, a truncated pyramid, as seen with the right eye, and another image of the same object as seen with the left eye, by relaxing the ocular accommodation the two drawings will appear to combine to form the "real" representation of the object (Fig. 58). Another illustration of the importance of the mental element in visual perception is the fact that the "blind spot" —the area in the retina where the optic nerve has its exit—does not

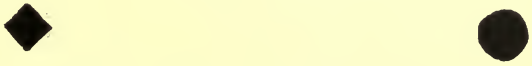

FIG. 59.—Diagram to demonstrate the blind spot.

interfere with binocular vision; in fact, for double-eyed vision there is no blind spot. The part of the visual field for which one eye is blind is seen by the other eye. The blind spot can be readily demonstrated by the diagram in Fig. 59. If the centre of the diamond is fixed with the right eye (the left eye being closed) and the book held at a distance of seven or eight inches is moved slowly towards or away from the face, it will be found that at a certain distance the circular disk will disappear, due to the fact that the image of the disk falls upon the point of exit of the optic nerve.

From the purely physical standpoint there is but one "space" and that is invariably the same; from the psychological point of view there are four forms of space. All space perceptions derived through skin sensations are bi-dimensional (breadth and length); the same is true for visual percepts derived through monocular vision. Cutaneous sensations combined with movement (active touch) and binocular vision combined with movements of the eyes give rise to three-dimensional vision (length, breadth and depth).

There are other sensory means for localizing objects in space, though in a less definite manner than by means of vision and touch. Odors and sounds may be localized through variations in their intensity which follow change of position of the body, especially as in turning the head. Sounds may be localized with greater accuracy than odors, but only with difficulty unless they are familiar.

Space Perceptions Illusory.—Many of our perceptions of space are illusory; this is especially true of perceptions with respect to distance, magnitude and form. A moment of reflection will serve to recall examples. The form of a square object does not appear square; the size of a familiar object at a distance is correctly perceived, while an unfamiliar object by its side appears smaller than it really is (see Illusions, Chap. IX).

Time Perception.—From a physical standpoint, the concept of "time" is a mathematical abstraction. The unit of time, the second, is invariable, and each instant of time is like every other instant.

Time which is experienced mentally is psychological time and differs from physical time in that the latter is always "limited."[7] If one tries to think of the present moment as contrasted with some other moment, he finds that it too is past, before he really has had time to think of it.

Mental states may follow one another without the experiencing person having any notion of the fact that there is a succession of mental states. The "feeling" that there is a succession is necessary for time perception. This feeling is a feeling of now-*ness* or then-*ness* which adds the necessary link between two or more experiences, serving two units in a way which permits the change from one to the other to be noted.

The idea of time is said to be scarcely traceable in children before the third year.[6] All sensations possess the attribute duration. Position in time is made possible by the fact that a single psychical element enters into relationship with other elements. One sensation is distinguished from another because it follows another. The present moment is arranged in a series and forms part of it, in relation to other experiences, and the result is a *temporal perception.*

From what already has been said, it may be assumed that if two mental states (sensations) could be considered as occupying consciousness independently, when the first state is forgotten the second would

appear, and there could in that case arise no idea of time. In order to pass from one mental state to another, in consciousness, a mediate mental state must be interposed. This latter mental state, however, must not be of sufficient intensity and interest as to cloud the first and second mental states, for the reason that they must always remain the principal point. To this there must be added the *recognition* of the principal mental states as the starting and ending points of the series, whether there be two or more than two mental states. If a person were to receive a blow on the head producing a state of temporary unconsciousness, it would at once be admitted that during the period of suspension of consciousness there can be no idea of elapsing time, in fact no idea of any kind. The mental state *A* at the time the blow was received and the mental state *B* at the moment of regaining consciousness are not connected by any mental state to fill the gap.[16] In order that time perceptions may occur there must exist a consciousness of change from one mental state to another, and the gap between *A* and *B* must be filled by some constant sensation or feeling which persists while the change of mental state takes place.

It is by the sense of hearing that duration is most distinctly subdivided. When listening to a series of monotonous sounds, there is a tendency to break up the series in some rhythmic fashion, as in groups of two, three or four. This is not due so much to the direct sensory effect as it is to the motor element in the reaction which involves the kinesthetic sensations produced by the contraction of the *tensor tympani* muscle of the middle ear.

Perception of Rhythm.—Many of the bodily movements give rise to sensations belonging to the group of organic sensations known as the kinesthetic sensations, including the muscular, tendinous and articular (joint) senses. These experiences commonly alternately change in intensity from stronger to weaker sensations, as, for example, in walking and dancing. The kinesthetic sense here furnishes a form of actual sensory experience which constitutes the basis for the perception of rhythm, as is shown in the familiar habit of beating time with the foot while one listens to music. Rhythmic perception may be aided by visual impressions, but this doubtless is dependent fundamentally upon the ocular movements, which again reduces the process to a kinesthetic basis.

Temporal Illusions.—As already has been mentioned, physical time is invariable, while psychological time is ever changeable. A period of activity seems much shorter than a period of idleness, and indeed during a period of anxious expectancy, time seems to be at a standstill. The sense of "the almost indefinite prolongation of time" as the effect of the action of *Cannabis indica* is graphically described by H. C. Wood in an experiment made upon himself by taking a large dose of the drug. "Seconds were hours; minutes were days; hours were infinite."[17]

Perception, then, may be considered as the fusion of a series of sensory experiences which, in their aggregate, as the result of accompanying states in the nervous system, give rise to changes from the standpoint of the relation of the experiencing subject to the object observed. Time and space cannot be said to be sensations, but they represent forms in which sensations are experienced.

Memory Processes.—It is generally recognized that as the result of practice an act may be repeated with greater ease in proportion to the frequency with which it has been performed. In other words, all stimuli acting upon the nervous system apparently leave some trace upon it. Under the same stimulus repeated or a similar kind of stimulation, the effect upon the nervous elements which occurred with the first stimulation is reproduced. Whether the neural excitation takes place in the spinal centres or in the highest cerebral centres, there becomes established a tendency for the reaction to be repeated whenever the proper stimulus is presented. As has been pointed out in a previous paragraph, there is involved an elementary association or connection in which psychic elements are united in the mental activities which collectively we call "thought processes." It has also been stated in the discussion of apperception that much of that which is present in consciousness is dependent upon past experiences. This is based upon the assumption of the existence of the power to recall impressions and ideas which previously formed a part of consciousness. The process by which recall is made possible is called "**reproduction.**"

At the time that an excitation in the nervous element takes place as the result of a given initial stimulation, other nervous elements than those at the site of the original excitation become affected, and a similar tendency to reactivity is brought about with the excitation of the second group of elements. Similarly group after group of neuronic elements may be thus indirectly affected. In this way, when any group of elements is stimulated to activity, the excitation spreads again to all those which were previously stimulated with it, and, at the same time, still other groups of elements may be included. With the repeated application of stimuli there are developed larger and larger groups or "associations" of nervous elements and therefore associations of mental processes. The rise of one group of impressions tends to arouse other impressions which were present at the time the original sensation, perception or idea was experienced.

It must be remembered that the term "impression" is to be considered as used solely for convenience in the elucidation of psychological processes. Several such terms are borrowed from physiology, and are used freely, but in a restricted sense only. Clinical facts connected with sensory and motor aphasia were sufficient in the opinion of Wernicke to prove the principle of localized "memory images." It is on this basis only that the doctrine rests, which foundation is inadequate. In organic diseases or destruction of the cerebral cortex, certain centres

may be so damaged that the corresponding kinds of stimuli cannot be received, and therefore certain kinds of mental experience cannot be repeated; for the same reason, and as the result of the same damage, the possibility of recalling such impressions is removed.

Such structural defects, amounting to deficit, result in a memory loss (amnesia), which may be visual, auditory, tactual and so forth. When the facts are analyzed, we find that the doctrine of localized memories is not sufficient to explain the phenomena noted. There remains, in addition, a subjective element to be considered; that subjective element is a "feeling" of familiarity which is essential to the second component of a memory process, namely "recognition."

In an earlier chapter, attention was called to the fact that one of the fundamental phenomena of living things consists in the ability to "store up" the effects of stimulation. The lower organisms differ from the higher in that the former lack the power of recognition of the effects produced by stimuli.

In the reproduction of an idea, the process consists in the rise of a new idea rather than the bringing up of an earlier idea in its original form. The new idea originates from the number of preceding ideas by the process of association.

Memory processes may be reduced to certain combinations of elementary processes related by similarity or contiguity, noted under the discussion of association. The combination of similarity Wundt calls combination of "identity." For example, the sensation yellow can call up the yellow which has been seen in the spectrum (association by identity), and again may call up the adjacent color orange (association by contiguity).

Memory is dependent upon *impressibility* and *retentiveness,* and may be said to be a complex process consisting of at least two mental operations: (1) the process of receiving impressions and (2) the power to recall those impressions, assuming that retentiveness is essential. Receptivity includes both the receiving and the conservation of impressions, and is dependent upon the perceptive process. When the field of consciousness is entered by an impression arising from one of the various forms of sensation, there follows a modification of the mental state which makes the recall of that impression possible by the association with a previous idea.

From the foregoing it will be understood that what we ordinarily call memory is in no sense, unless it be in a very narrow one, to be considered as a single mental process, but should be regarded as an aggregate of mental processes, the ultimate effect of which is to reproduce states of consciousness and therefore to reproduce mental experience. Although the element retentiveness is an essential, it does not enter as an active mental process. We can now see the significance of the statement of Ribot to the effect that there are memories, but not only *one* memory. The mere tendency to repeat an act once performed

cannot truly be said to be the result of a mental process which can be called memory. All motor acts are at first brought about with conscious effort; the infant attempting to walk, the effort of learning to ride a bicycle, playing a piano, and the more difficult feats of the trained athlete are familiar examples. By practice the muscles are trained to a marked degree of accuracy of movement, which ultimately may be carried on without conscious effort taking part in the production of the movement. This is often spoken of as "organic memory," but, in the strict sense, such motor acts are operations that were once such as could be carried out only with the aid of conscious effort, but have since become simplified in that they have become automatic. Such motor acts become more and more like the operations that are purely spinal in type. Consciousness is a necessary factor in the production of the first experience of producing a complex motor act, or any other mental experience at the time of its initial incidence; in the same manner consciousness must be a factor in the reproductive process in order to give rise to a memory in the true meaning of the term.

Imagination.—In its generally accepted use and in ordinary parlance, the term imagination implies the construction of mental images (ideas) out of past experience and their arrangement in such combinations as previously have not been formed. Psychologically speaking, this process is termed constructive or productive imagination. Strictly speaking, no imaginative process produces mental elements which are new, but what actually happens is that old elements are rearranged. Originality of thought, therefore, at best, consists of new combinations only of mental elements which have been already experienced. Just as in the matter of memory there must be an accompanying feeling of familiarity, so with imagination there must arise the feeling of "strangeness," [7] in order that in the strict sense the experience may become an imagination. As the term implies, imagination deals with the image of a former percept, reproduced in consciousness. The object of experience comes into consciousness again in imagination without being presented to the senses. Discoveries in scientific and other fields depend upon the ability of the investigator to determine the combinations of his experiences which are best applicable to certain other experiences. "The discovery of some single statement, the brief formula, from which the whole group of facts is seen to flow, is the work of not the mere cataloguer, but a man endowed with creative imagination." [13]

It consists in the ability to abstract from experience and to picture the different possibilities with all their consequences in order to find by this means a new reality, not accessible to direct experience.[16] The same holds true for artistic and poetic creative ability.

Imagination possesses many points of similarity in common with memory; in fact, it differs from it but little, in that the real difference lies not so much in the mechanism of the process itself, but rather in the attitude assumed by the subject towards the product of the imagination.

Memories refer to definite periods or events in the past, while imagination, even if it does deal with actual past experiences reproduced and rearranged, does not recognize them as such; on the contrary, the product of imagination is characterized as having the quality of unreality. When this quality disappears the imagination no longer exists as such, for it becomes transformed into a memory of a real experience or a product of immediate perception.

In dealing with the subject of morbidly falsified sensations as they occur as a part of the symptomatology of mental disorders, the use of the term imagination will be conspicuously absent, for the reason that this type of mental activity does not take place in mental disorder except in the same manner that it occurs in mental health. The sensational and emotional disorders, which in so many instances are directly responsible for the patient's actions and statements, are to be regarded as real experiences from the patient's standpoint.

Judgment, Reasoning, Belief.—Judgment depends upon the comparison of ideas by association, together with the direction of the attention to one of two alternative ideas which may arise from the analysis of the associated concepts. The important element in the process of reaching a judgment is the voluntary attitude assumed by the subject when the judgment is formed. That is, the attention must be actively directed towards certain experiences (percepts) and the ideas which represent those experiences. The necessity of the voluntary attitude of the judging individual is emphasized by the statement of Tichener that "judgment belongs to the same psychological genus as voluntary action." [7]

True it is that previous experience operates in a large measure in the form of suggestion which influences the judgment, with the result that very few of our judgments are strictly the result of pure logic (*vide* Complexes, p. 112). There are, nevertheless, always present alternative possibilities (ideas), either of which may be found to be the more acceptable at the time the judgment is reached.

Furthermore, habitual associations are frequently operative to such an extent that they actually control the resulting process; thus, for example, the idea "grass" usually gives rise to the idea "green"; we say, it naturally calls up the idea of green, which means that by habit one becomes accustomed to associating the two ideas, that the one is responsible for the rise of the other idea.

Logic would call judgment a proposition because it does not pretend to say whether a given proposition is true or false. It has been emphasized in this description (p. 83) that immediate sense impressions play an important part in the gaining of knowledge of the external world, but that much of that which is learned is gained through experiences that have occurred and in some way are fused with present experiences. Reasoning is essentially an association of judgments. Essential to the formation of a judgment is the idea which represents

a certain mental construct (percept) in the abstract which embraces all that is included in a given class, or it may mean the object or thing that is mentally depicted. The logician assumes that concepts (ideas or notions) are formed first, *e.g.*, the concept "man." In truth, however, it must psychologically represent a certain kind of idea, that is to say, it must possess certain qualifications in order to distinguish it from the concept "horse." It is impossible to state this without giving expression to a judgment already formed, *e.g.*, "a rational animal," which fact would disturb the logical order of rise of these three mental activities, and which illustrates well the importance of suggestion and habitual association already mentioned. If this element of suggestion did not exist the logical order would have to change to a psychological order in which upon analysis the concept "man" would seem to be the outcome of a "rational-animal" judgment; indeed, the result of the comparing of two judgments, the second of which would imply that "some animals are not rational," which in turn implies reasoning.

The active processes in reasoning are included by Pillsbury[18] under four heads.

The first requisite, as is true concerning the rise of all mental processes, is some stimulus which initiates the reasoning process. To produce this necessary stimulus there arises a difficulty in the form of some hindrance to continued action or thought. There arises, therefore, a necessity for a choice of ideas, or a desire to change from mental or bodily inactivity to activity.

The second part of the process involves the analysis of the difficulty, which gives rise to the formation of a judgment. This is followed by the rise of a means of removal of the difficulty, constituting what is usually termed "reasoning by inference," which is similar to the process of "trial and error," referred to in the description of mental development (p. 70). Finally, the judgment must be determined as either correct or incorrect, which test constitutes proof, which is the usual requirement for the logical and psychological justification for the existence of a belief. Judgment, for the time at least, does imply the belief in the correctness of the proposition, as opposed to logic, and, from the psychologic standpoint, judgments are practically beliefs until they can be shown to be erroneous. Herein lies the differentiation point which distinguishes error from morbidly falsified beliefs such as are met in delusional states.

It may be said that reasoning practically consists in a further elaboration of the association and comparison of judgments (propositions) through which, for the time being, an ultimate conclusion is reached, which, by reason of adequate proof, becomes acceptable as a belief. Belief may be considered by the student of practical psychiatry as a conclusion which has been reached as the result of the comparison of experiences. The process of reasoning is necessary for perfect mental adjustment to environmental situations whenever the welfare of the individual is concerned.

Speech.—Among the mental acquisitions of the human being none is more complex than speech. It is difficult at first sight to differentiate the mental elements in speech from those that are purely motor arising as the result of a specially developed habit or form of behavior.

Hughlings Jackson,[19] who was a pioneer in the study of speech defects caused by cerebral disease, classified spoken language in two categories: intellectual speech—depending upon the power to convey propositions; emotional speech—depending upon the power to convey feelings. Although Jackson partly based his conception of the mental aspect of speech upon the psychology of Herbert Spencer, he evidently recognized the facts which form the basis of the present-day conception of speech as a mental achievement, namely, "it is more than a product of thought; it is the instrument which makes thought possible." [11]

Several theories have been postulated in regard to the origin of speech. The first theory assumed that as speech represents one of the distinctive differences between man and the lower animals, it must have been acquired through a special creative act. This view, of course, does not take into account the fact that lower animals also make use of their vocal organs to communicate with one another. The more tenable speech theories are those known as the "imitation theory" and the "interjection theory."

In the first it is held that the natural tendency to the imitation of sounds furnishes the origin of spoken language. Although imitation is possible with some animals, yet there are no indications of their having developed language, as has been done by the human being.

Nevertheless, the first steps in the development of the power of speech are those of imitation. The sounds first made by the infant are purely reflex, as are other bodily movements, and are free from the tendency to imitation of sounds heard. Later, coincident with the development of this tendency, which, as is well known, becomes very strong, the child imitates the sounds of animals, and indeed uses those sounds to indicate his recognition of those animals. The same mental process operates in the adult, when he uses language as the symbol of thought, and in the familiar "thinking aloud" of some persons.

In mentally disordered persons, this thinking aloud may be so pronounced that practically all mental activity gives rise to vocal expression of the thought content. Concerning the question as to which occupies the position of priority, ideas or language, it must be stated that both develop together, and that the one is necessary to the development of the other.

The interjection theory of speech was founded on the basis of the belief that in the earliest period of development of language, speech became an outgrowth from the ejaculatory expressions evoked as the accompaniments of sudden stimulation. The ejaculations later came to be used to represent the experiences with which they were asso-

ciated, and were used as a means of conveyance of ideas representing those experiences.

In general it may be said that the responses of the vocal mechanism, and all the motor apparatus connected with it, are the responses to sensory stimuli, and are used as a means of emotional expression.

The further use of the speech apparatus as a means of expressing ideas is the result of a slowly developed function which in its early stages, as already stated, is largely dependent upon the instinct to imitate. Again the utterance of sounds of one kind tends to produce the same emotional state in the individual who hears the sounds as in the one who utters them.

This is especially true of sounds made by animals for the purpose of arousing emotional attitudes, according to whether conditions are favorable for the habits of the animal, or whether they are dangerous.

In language sounds become related to ideas as well as to emotional states. In the evolution of language, as a means of conveying ideas, gesture and pantomime were the earlier mode of expression. The use of the vocal cords in speech later displaced the gesture, and has become separated from other forms of bodily activity, and is a highly specialized system of behavior,[11] which has become modified and "controlled by social convention rather than by natural necessity."

The Unconscious.—As an outgrowth of the French school of abnormal psychology, led by Charcot, and continued by his pupils Janet and Freud, whose methods of study of hysterical states and other psychoneuroses were based largely upon psychological analysis, there has in recent years arisen, under the leadership of Sigmund Freud, a school which has gained prominence on account of the mental examination of the subject by the so-called "psychoanalytic" method.

Janet developed, through extensive clinical study of patients at the Salpêtrière, the doctrine of "dissociation of consciousness," on the basis of which the symptoms commonly met in hysteria were explained. Among these were such symptoms as anæsthesias, paralyses, contractures, convulsive attacks, blindness, deafness, and the visceral crises, such as vomiting and anorexia. Among the mental states observed and studied were fixed ideas, obsessions, aboulias, phobias, amnesia, and disorders of consciousness, especially somnambulism, hypnoidal states and alteration of the personality.

It has been emphasized by Janet[20] that the hysterical anasthesia of a limb does not correspond with any anatomical nerve distribution, and that the patient, not knowing that the immobility of the fingers is really due to a muscular disturbance in the forearm, considers the popular idea of the limb rather than the anatomic conception. The anæsthesia is, therefore, stopped at the wrist, as would correspond to the notion of the uneducated, who naturally would think that the hand does not move because the hand is affected. Janet concludes, "So these hysterical anæsthesias seem again to have something mental, something intellectual in them."

Furthermore, we are reminded by Janet, that insensibility to heat and cold and the consequent accidental burns received in consequence of organic nervous lesions (syringomyelia) are not seen in hysterics, for the reason, as will be shown presently, sensibility, which is the natural safeguard of the body, is not really wanting; in fact, it can be proved that the hysterical patients do feel; again, hysterics are not inconvenienced by their anæsthesias, and, indeed, may not know that they are anæsthetic in a limb and may exhibit surprise when the fact is pointed out to them.

An interesting example of this fact is related by Janet, a young girl who had severed part of the median nerve and experienced a numbness of the palm of the hand, extending to the thenar eminence, the site of the injury. Upon further examination of the patient it was found that she was hemianæsthetic on the opposite side, of which fact she had no knowledge. Such anæsthesias are considered to be due to an incapacity to form elementary sensations into general perception; the ability to mentally connect the sensation with the personality has disappeared; sensations are no longer connected with the totality of consciousness, and are, therefore, said to be "dissociated."

In 1895 Freud, stimulated by the study of an hysterical patient with Breuer, published a proposed theory which indicated a distinct deviation from the original basis of investigation. Many of Freud's patients related dreams during the mental examination, and to this attention was given and careful, detailed investigations were carried out which revealed certain traces of earlier mental traumas to which the patients reacted in such a way as to produce a profound and lasting impression, which, although apparently forgotten by the patient, played an important part in the production of the psychoneuroses.

Freud's theory is founded upon the hypothesis that what we ordinarily call "conscious states," which are the result of actual experience, cover only a very small part of the psychic life of the individual. All the other mental phenomena, that is, those which are not conscious, according to this doctrine, must be included with "the unconscious," which is related to psychologic laws, as are the phenomena of conscious mental states. Furthermore, it is assumed that mental phenomena which arise in the unconscious have an influence upon conscious mental states and upon the reactions of the individual as a whole. Study of the hysterical symptoms induced the belief that they were somehow related to certain mental traumatisms acting as causal factors years after their occurrence. Examining the patient's mental life for the period preceding the trauma, Freud found that apparently unimportant objects of experience were reacted to by the patient through a singular predisposition, leading to the suspicion that the patient had, perhaps in early life, some serious and similar experience that originally produced a profound emotional reaction which in later years seemed entirely banished from thought. As a matter

of fact, this is not the case, but by reason of certain mental "mechanisms" the memory of the experience is kept out of the conscious train of ideas.

Parallel examples are considered as existing in the minds of all normal persons. The one frequently cited to illustrate this is the mental state which we have been accustomed to term "mental bias"; the familiar instance of the party politician commonly is employed for the elucidation of the theory. When such a person is about to offer an opinion concerning a given plan or policy, his point of view, and therefore his conclusion, is unconsciously moulded by a certain system of ideas, of which the person may be innocently ignorant, and therefore he actually believes that his conclusion is reached by a purely logical method of thought. According to Freud, the political opinion held by the individual is directed by a "complex," of the assistance of which he is unconscious. Furthermore, it is essential to consider that this, or any other similar complex, be it religious or otherwise, carries with it a definite emotional tone. The complex does not become active, however, unless there is something to stimulate it to activity. This may come about through the rise to activity of one of the ideas comprising the complex, as by the process of association, or by the usual means by which ideas arise, namely, by some real experience, some external stimulus. Much of the every-day normal thinking is believed to be accomplished in this manner, rather than by a strictly logical arrangement of ideas.

The effect of complexes upon the train of thought has been shown by Jung and others [21] by means of the so-called association experiment. A series of words as "stimulus words" are selected, and the patient is instructed to say aloud the first word that comes into his mind after he hears the stimulus word given by the examiner. The time required for each "reaction word" (ideas) to be expressed is noted in seconds.

The experimenters found that in certain instances the reaction was unusually late, especially when the stimulus word was such as to arouse a complex. As an example the following list was given to a patient who attempted suicide by drowning:

Stimulus word	Reaction word	Reaction time
1. Head	Hair	1.4
2. Green	Meadow	1.6
3. *Water*	*Deep*	5.0
4. Stick	Knife	1.6
5. Long	Table	1.2
6. *Ship*	*Sink*	3.4
7. Ask	Answer	1.6
8. Wool	Knit	1.6
9. Spiteful	Friendly	1.4
10. *Lake*	*Water*	4.0
11. Sick	Well	1.8
12. Ink	Black	1.2
13. *Swim*	*Can Swim*	3.8

The reaction words in italics are those which are aroused by the complex, and the reaction time is accordingly lengthened. This method is used as one of the steps in the psychoanalytic examination of the patient for the determination of the complex operative in the given case.

The next part of the theory to be considered is the manner in which complexes become a factor in the production of abnormal mental states.

According to Freud, the complex which is responsible for the psychoneurosis is the one that carries with it a mentally painful emotional tone; many complexes are therefore of such kind as to be inimical to the comfort of that which goes to make up the personality. It becomes an undesirable and therefore unharmonious element and there is consequently a tendency to exclude the unpleasant complex from consciousness. In the same way the normal person gives attention to pleasant experiences in life and allows the unpleasant ones to be "forgotten." According to the Freudian theory the forgetting process is arrived at by what he terms "repression." This results in an inhibition of the power which complexes naturally possess of exerting an influence upon the train of thought. The complex, therefore, becomes relegated to the unconscious, and meets with a continued resistance which keeps it out of consciousness. The resistance is regarded as a force, which Freud indicates under the name "censure," and uses in the same way that the physicist employs the terms atoms and ether waves. This force is, therefore, presumed to be constantly active, in order that the state of "repression" may be maintained.

Furthermore, it is assumed that two or more complexes, on account of the character of their content, and the nature of the accompanying emotional tones, may be inherently antagonistic to one another; there arises a state of mental "conflict," which normally results in the abandonment of one in favor of the other, or in a change in the character of one complex, so that it can harmonize with the other. In abnormal states, however, such adjustments cannot be made, and the result is the production of the symptoms already mentioned, as met in hysterical and psychoneurotic states.

In illustration, Freud states, "Suppose that a young man, dependent on a rich father, falls in love, and that the object of his choice meets with his father's strong disapproval. In his despair the thought may occur to him that were his father to die all would go well, and, to his horror, finds himself playing with this thought in his imagination, and even for a moment half wishing its consummation, or, at all events, not being prepared to regret it as conscientiously as he considered he should. A normal man under these circumstances would honestly recognize the existence of the wish in him, though he would, of course, realize that for pious and ethical reasons it would obviously have to be surpressed; this would probably be an easy matter, for the ethical

part of his personality to which the wish is inacceptable would evidently be stronger than the part corresponding to the wish. A neurotic, on the other hand, is more likely to react towards such an occurrence by not owning to himself that he ever had such a wish, even momentarily, and by striving to get away from such an unpleasant thought, to forget or repress it." [22]

The repressed complex, namely the wish for the death of the father, continues to influence the conscious mental states, and the emotional attitude originally held towards the complex and component ideas may be transferred to other objects of thought. This is technically termed "transference" (Ueberträgung), and implies that an idea arising later may act as the representative of an earlier idea; for example, in children, the transference of affective processes to a doll, and in adults, especially unmarried females, the transference of affection to pet animals.

In the analysis of his patient's mental states, Freud reaches the conclusion that the traumatism already referred to was apparently not the only factor in the production of the abnormal state, but that often there were occurrences in the sexual realm, and that the trauma was simply a causative factor in bringing up a complex, which until that time was not conscious, and existed as a sexual or erotic conflict, and which has given rise to the so-called "sexual theory" of Freud's psychopathology.

Freud's earlier practice was that of hypnotizing his patient in order to produce another state of consciousness, during which the patient was questioned, usually resulting in bringing to memory certain facts of which the patient in the ordinary waking state was unconscious. Later, it was found possible to get the same result without resort to hypnosis. When unable to obtain further data by questioning, the patient is asked to relate anything and everything which comes to his mind, whether it seems sensible or without meaning; this train of ideas usually leads to some idea which is the key to the complex. This method was found not to be as valuable, on account of the fact that results were not easily obtained, except in instances in which the resistance (censor) was comparatively feeble. It was this experience which led Freud to adopt the study of the dream-life of the individual.

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CHAPTER VI

ETIOLOGIC FACTORS IN MENTAL DISORDERS

THE determination of the causal factors at work in the production of mental disorders is usually a complex problem. The difficulties frequently arise from the fact that the change from the normal mental state often takes place insidiously, while the operative causes may have ceased to act. In attempting such an estimate it is essential to learn, as far as possible, the nature of the mental change that has taken place in the individual at the time that he passed from the normal to the abnormal mental state, and also to determine the patient's normal mental standard. The only mental standard by which, for the requirements of psychiatry, a comparison can be made is that of the established normal of the individual, which standard has developed from the "sum-total of his mental experiences."

Mental disorders are manifested as an alteration of attitude of the patient active or passive towards his environment; by the change in the character of his reactions his inability to adapt himself to the environment is demonstrated. Reactions become different from those which would occur in health under similar conditions, and the individual no longer can be said to be able to adjust himself to environmental influences.

Close study of the etiology of mental disorders has resulted in the accumulation of much evidence which strongly indicates that the causes of mental disorders are usually multiple. For example, in the light of this fact there would be no justification for concluding that pregnancy is the sole operative cause in psychoses arising during or shortly after the period of gestation. Furthermore, mental change following directly in the wake of profound mental shock, without other assignable operative cause, must be considered as occurring in individuals having been previously in a prepared state, by reason of the presence of some other causative factors.

Reactions to Causal Conditions.—To return to the biologic parallel, it may be assumed (1) that certain conditions are essential for the performance of the functions of an organism; (2) that more or less definite physical states must necessarily exist with respect to the materials constituting the organism, in order that the organism may react to the effects of external agents; (3) that this reaction is dependent upon the presence of certain factors, and the absence of the factors which would tend to neutralize those reactions.

Also, the environment must be such as to favor the operation of those agents, with sufficient intensity and duration, in order to bring about a reaction on the part of the organism. It may be assumed,

furthermore, that in the case of a given causal agent operating in an individual not predisposed, whether the agent act intensely or feebly or for long or short duration, no reaction beyond the normal is likely to follow.

It may similarly be inferred that the person whose reactions in response to operative causes occur in a distinctly abnormal manner, either qualitatively or quantitatively, should be regarded as a person differently constituted from the average, from the standpoint of the nervous system—the organ of adjustment. With this fact in view, the causes of mental disorders, like all causative agents, fall into two groups; the *internal* or *predisposing,* and the *external* or the *exciting* causes. The line of demarcation is not to be regarded as sharply drawn between the two groups.

It is impossible to state what happens in a nerve-cell at the time of, or subsequent to, the action of a stimulus received by a peripheral end-organ; nor can any one say what occurs in a motor nerve-cell when an impulse is "generated" within it to be sent out to a muscle-cell; in fact, it is impossible to state what changes take place in the contractile substance of a muscle-cell when it shortens, or in an epithelial cell when it secretes. These phenomena, nevertheless, are known as the effects of cellular activity and the fact that certain kinds of reaction are peculiar to certain cells can be easily shown. Some facts concerning the functions of nervous tissue are known by their effects or reaction in health, and also by the resulting symptoms manifested by disturbances of function in disease or disorder.

Still less, however, can we say what occurs in neuronic elements when the sensations and perceptions are experienced, or during an accompanying emotional state. It may be inferred from that which may be said of any cellular structure, that this phenomenon, mental or physical, is the accompaniment of cellular activity—reaction.

Many neuronic activities take place without the occurrence of psychic phenomena, but mental processes do not exist without corresponding neural activity.

It is well known that the circulation of the blood is one of the essentials for the continuation of cerebral activity of all kinds; so it is essential for renal function or the activity of any other organ. In this respect, therefore, the nervous organ does not differ from any other organ. The kidneys of one individual may in consequence of an attack of scarlet fever become the seat of an inflammatory reaction, while in another individual no such effect may be experienced. One cannot say on that account that the inflammatory reaction is solely due to the severity of the infection or the intensity of toxicity. Apparently mild attacks of scarlatina have as sequelæ very severe nephritic involvement. It must be said that in such instances the resistance of the tissue is lowered, either by a defective state of nutrition or some

inherent defect in the protoplasm of the cellular constituents, by reason of which they are unable to withstand the toxins of the disease and the accompanying metabolic disturbance.

The same attack of scarlatina, or typhoid, or influenza, or pneumonia, or the pregnant state may be accompanied by a train of symptoms referable especially to a disorder of the nervous system. In diphtheria it is not uncommon to find a sequel in the form of a motor paralysis, due to the involvement of the cells and fibres of the lower motor neuron. Accompanying any of the infectious diseases nervous symptoms may present themselves as an affection of the activities of the mental sphere. The cerebral organ, its sensory centres, and association areas are shown to be involved by abnormal reaction. We cannot say why and how this occurs, any more than we can explain the disturbance in the instance of the kidney disorder. We do say that by reason of some altered condition of the nervous mechanism its resistance is lowered, giving rise to a predisposed state.

Predisposition.—The question of the nature of predisposition to disease furnishes a subject of vital importance in the study of all pathological conditions, and in the domain of psychiatric medicine reaches its highest importance. Predisposition is an internal factor which seems to operate in some degree in every case (Lugaro). In some instances it predominates to such an extent that the tendency to mental disorder may be so strong as to make itself evident without any apparent external or exciting cause operating with it. Such strong predispositions give rise to mental **anomalies** rather than to true psychoses; in the first instance there is an aberration of organic development without assignable external cause, the second an abnormal process, the result of an external action which disturbs the function of the organs by injuring them in some way, to which injury the organism reacts as a whole, either to recover or to succumb to the effects.[1]

Anomalies and predisposition are generally considered to be phenomena which are congenital and hereditary. These anomalies may exist in the form of defects in the structures of the nervous system, and also may depend upon defects shown either in hyperfunction or weakness of other viscera, *e.g.,* defects of the digestive or renal apparatus, the thyroid gland or the genital glands. Morbid predisposition may be acquired in adult life after infections diseases or traumatism. As an example may be mentioned the acquired intolerance for alcohol.

It is to be emphasized that in no instances are special pathological conditions transmitted from parent to child, but the predisposition to the development of abnormal states which may be manifested in many ways is often evident in progenitors and offspring.

"The new individual inherits the bulk of its inborn characters from its parents, but possesses new characteristics of its own in the

form of variations." "Acquired characters are those that are due to the action of various stimuli upon the organism from the time it commences its existence as a fertilized ovum." "But these characters could not appear unless the potentiality of producing them were present in the fertilized ovum and in the cells derived from it."[2] This potentiality is in itself an inborn character. Acquired characters must be regarded as modifications of inborn characters produced by external stimuli.

Predisposing Causes

Under the head of predisposing causes fall several factors which appear to favor the development of mental disorder. These factors are active in so far that they are elements concerned in the preparation of a soil favorable for the development of pathological mental states. These predisposing factors are: (1) heredity; (2) education and environment; (3) age; (4) sex; (5) race; (6) occupation; (7) previous attack. These factors, it will be observed, are clearly biologic factors in a large measure, in so far as they concern either inborn or acquired characteristics.

Heredity.—The belief that heredity has something to do with the occurrence of disease, especially those disorders accompanied by mental symptoms, has prevailed for a long time. Heredity has, in fact, been regarded as the greatest of the predisposing factors. This, in a measure, is still regarded as correct, but only in a restricted sense. For example, as is now held to be true in regard to the matter of syphilis and tuberculosis, those diseases without doubt are congenital in some instances, but such examples are instances of the result of contagion rather than an "inherited syphilis" or "tuberculosis." The use of such terms has been the outcome of custom rather than accuracy.

It is a matter of frequent observation which brings to one's notice similarities of features among members of the same family. In some families the tendency for the occurrence of certain peculiarities appears much stronger than in other families. A child may present so strongly the characteristics of one parent as to be conspicuous; or he may possess in part of his make-up mental and physical characteristics of one parent, and in part those of the other parent. This may be especially noticeable in stature, in the color of the eye, the color of the hair, or the shape of the nose, or in mental traits.

Using the color of eyes as an illustration, the deeply colored irides owe their depth of color to the formation of pigmented cells on the anterior layer of the iris. In the light irides there is an absence or very little pigment in that layer of the iris. Studies of pedigrees indicate that the brown color of the iris is a dominant characteristic and that the light color of the iris, due to the absence of pigment, is a recessive characteristic.

Abnormal characteristics may be seen both in progenitors and offspring, among which may be mentioned certain forms of cataract, retinitis—pigmentosa, night-blindness, color-blindness, albinism, hemophilia, and brachydactylia. The appearance of such traits seems, in the light of studies made in recent years, to accord with the Mendelian Laws referred to in a previous chapter. The law of heredity appears to be the same for the occurrence of physiological as for the pathological tendencies. Characters not possessed by one or more progenitors cannot be transmitted to offspring. Assuming that the properties of organism are due to the presence of detachable elements (determinants), certain characteristics *may* or *may not* be present in the germ, and the offspring may be a pure breed for the presence or absence of the character in question.

The application of the Mendelian Laws * of heredity to the study of disease in man is difficult for the reason that, obviously, human beings cannot be controlled as Mendel controlled his plants, and on account of the fact that in human beings the problem deals with much more complex organisms. Again the fact that either very few or no offspring are born in some instances, and also the occurrence of miscarriages or still-births in other instances are certain to upset calculations made upon a Mendelian basis.

Atavism.—Children of parents who have suffered from mental disorder may show no signs of mental instability during any part of their lifetime. The predisposition in such instances remains latent; in the meantime apparently normal members of a family may be born, but in a third or fourth generation the taint may show itself in minor but in distinct forms. The skipping a generation and the reappearance of a trait not seen in the parent, but which has been latent in that generation, is known as "**atavism.**" This kind of inheritance seems to conform to the Mendelian Law.

According to Cannon and Rosanoff,[3] a study of the pedigrees of seventy-two patients, including 206 matings and 1097 offspring, showed that although there were several instances of neuropathic children born to normal parents, not a single instance was found in which a normal child was born of parents both of whom were neuropathic. From this investigation it was concluded that the neuropathic constitution, if it is transmitted according to the Mendelian Laws, must be **recessive** to normal. A similar study by Davenport and Weeks [4] of the pedigrees of epileptics resulted in the conclusion that when both parents are either epileptic or feeble-minded all their offspring are feeble-minded.

As a rule, the children most liable to the "hereditary taint" are said to be those whose birth was nearest to the attack of mental disorder in the parent (Regis). As an example of this, a child born of a mother after a psychosis of pregnancy, or begotten by a father while under the influence of alcohol, is particularly prone to mental breakdown, or to show distinct evidence of neuropathic taint.

* See p. 32.

"When a person carrying a taint, such as migraine, chorea, paralysis or extreme nervousness, is mated to a defective about one-half the offspring are defective." When both parents are "tainted," about one-quarter of the offspring are defective. Normal parents that have epileptic offspring usually show gross nervous defects in their near relatives.[4]

Mutation and Induction.—Finally, it has been observed that characters that are new to the stock may appear in offspring; these seem to arise without regard for the characteristics of the ancestors. Such characters are said to be due to spontaneous variation or mutation. For example, the clover which usually has a trilobate leaf commonly furnishes examples of the four-leaf variety. In the human species a similar phenomenon is found in the form of supernumerary digits. When these are present they tend to recur in inheritance. A neuropathic state may by *mutation* be created by the continued action of some toxic state in the parents, as in the example of the tendency to hyperthyroidism and its train of nervous manifestations. Stockard was able, by subjecting guinea-pigs to the fumes of alcohol before breeding, to produce dwarfed, weak and sickly offspring. Such instances are not to be regarded as characteristics which are truly inherited, for the reason that they appear to influence only the one generation. These are the instances which give rise to the examples of alleged transmission of acquired characteristics. The phenomenon is properly named "*induction.*"

More recently Stockard[5] has found that the members of F_3 generation are more affected than the F_1 offspring, making it appear that the chromatin is affected in the germ-cells and that it now appears to be a true inheritance. The possibility of the breeding having been carried out with stock already possessing some of the factors of degeneracy must be borne in mind.

It has been shown that genius is sometimes associated with a predisposition to mental disorder or other forms of nervous instability. Lombroso has said that "genius is a neurosis." In some families one member has been noted as a genius while others have been known as sufferers from serious mental and nervous disorders. Many men prominent in history have been credited with some abnormal state of the nervous system. Men of genius are said to have begotten children neurotic or feeble-minded. Julius Cæsar and Napoleon are regarded as having been subjects of epilepsy. Mozart, Peter the Great and Victor Hugo are said to have had defective children.

Among literary and musical geniuses there are several who are recorded as being distinctly abnormal. Guy de Maupassant died insane; Villemain is described by Victor Hugo as dominated by delusions of persecution; Jean Jacques Rousseau was of neurotic ancestry and believed himself persecuted by all the world; Flaubert is recorded as having died "of seizure of congestive epilepsy." Baudelaire is said to

have died of general paresis; Alfred de Musset was a drug habitué. Among the musical geniuses Robert Schumann was a melancholic; he attempted suicide by throwing himself out of a window. Donizetti died of general paresis. Mozart was extremely nervous and presented the type of precocious mind, being six years of age when he undertook his first concert tour. He died at the age of 35, and in his last years was tormented by the hallucination of a man who commanded him to compose his own funeral mass.[6]

Some imbeciles exhibit abnormal brilliancy in one particular, such as rapidity in mental calculation, or an unusual aptitude for remembering dates. Unusual dexterity in playing musical instruments may be possessed by imbeciles; for example, the person popularly known as "Blind Tom." Many of the "infant prodigies" are of this type and "more often than otherwise end in premature dementia or imbecility."[7]

Morbid tendencies which are inherited and made manifest in the form of nervous instability may be associated with corresponding functional changes related to the nervous system, or by some morphological variation from the normal. These changes and their "signs" are termed the **stigmata of degeneration.**

The term degeneration, from the standpoint of heredity, implies the *defective power to transmit perfectly normal characters or functions* (Macpherson).[7]

Heredity is termed dissimilar when a morbid process in a parent affects the sexual elements or the embryo to the extent that it develops with some new defect. For an example an alcoholic may have offspring that are epileptic or feeble-minded; a mother with normal nervous heredity, but who suffers from Bright's disease and eclamptic seizures during gestation, may give birth to a child possessing some stigmata of degeneration. This latter instance is an example of "congenital degeneracy," which must be distinguished from true hereditary degeneracy.

Similar heredity implies that the transmission of the true neuropathic disposition is recognizable by the appearance of similar affections in parents and progeny.

The percentage in which the direct inheritance of the tendency to mental disease varies with different observers from 20.5 per cent. (Hack Tuke) to 49 per cent. (H. Grainger Stewart); the former ratio is based upon 136,478 cases, the latter out of 901 cases, among which were included "eccentricity." Savage recorded 34 per cent. out of 1072 cases. Urquhart states, "The total neuropathic heredity reaches 72 per cent. of the persons received, and no doubt more accurate information would enlarge that percentage materially, and, of course, at the same time, diminish the number under 'acquired.' The percentage of psychoses alone in his experience was 45, but in the latest period of observation it rose to 48 per cent."[8]

Mott has shown that certain types of mental disorder are found in neuropathic families, exclusive of congenital or post-natal condi-

tions, such as paresis, brain syphilis, and vascular softening. Among 3485 patients representing 1620 families there were:

1	instance	of 7	in a family
2	instances	of 6	in a family
6	instances	of 5	in a family
27	instances	of 4	in a family
160	instances	of 3	in a family
752	instances	of 2	in a family

The majority of affected persons are directly and not collaterally related, as is shown in the following table compiled by Mott:

Father and son	83	Two sisters	227
Mother and son	108	Two brothers	150
Father and daughter	112	Husband and wife	76
Mother and daughter	174	Grandparents and offspring	29
Brother and sister	241	Other relations	224

The greater transmission from parent to offspring appears to be through the female side; there are also noted more daughters than sons in the offspring of affected parents.[9]

It must be observed that many individuals who die of "old age," without suffering any of the disease accidents, escape these because they were fortunate to have a favorable environment, and not because they were free from hereditary predisposition. In the same way individuals born with a nervous instability may escape serious disorder, while others similarly predisposed may develop psychoses, provided that the proper environment is furnished for the production of the disorder. Individuals who have contracted syphilis, or have been excessive users of alcohol and who have been subjected to severe mental strain, may die from the direct effects of those causes, although they do not develop psychic disorders; another group of individuals subjected to the same influences develop paresis because of a "lowered resistance" to the causal agents. The same may be said of the majority of the forms of psychoses.

Upon the basis of these observations it may be concluded that individuals who suffer from psychoses may be considered to form two great classes: 1. Those who develop psychoses irrespective of environment; for example, paranoia and manic-depressive psychoses. 2. Those who develop psychoses provided there exist the proper environment and exciting causes; for example, puerperal and other toxic psychoses, general paralysis and organic dementias. These in this sense may be termed *accidental* psychoses.

The relation of degenerate heredity, aberrant mental states and crime to each other may be mentioned here, though but briefly. Since the time of Lombroso, who studied the mental and physical characteristics of the criminally disposed class, there have arisen two camps of thinkers on the subject. The one regards the criminal as a product of a faulty social environment, and, although he may be

mentally defective in some instances, he is a criminal voluntarily and therefore should be regarded as wholly responsible for his acts. The other class of students of criminology follow the teaching of Lombroso with more or less modified views, to the effect that the criminal is born an abnormal individual. English prison reports show generally that one in every twenty-five male prisoners is of weak mind, or is epileptic, without including those whom it has been necessary to remove to asylums.[7]

The rate at which criminals, paupers and drunkards may be brought into the world is well illustrated in the study of the celebrated Juke family, which, with its numerous branches, lived in the State of New York. Seven generations of this family were traced from a single Ada Juke, "the mother of criminals." Out of nearly twelve hundred descendants, approximately one thousand were known to be prevailingly criminal, sexually immoral, inebriates or mentally defective; it has been also shown that these degenerates had cost the State over one million dollars; out of seven hundred members of the family one hundred and eighty received public aid for a total of eight hundred years.[10]

Criminals have been classified under several headings, thus:

(1) Those criminal by instinct, in which the individual, by reason of an arrest in development, is incapable of experiencing the higher intellectual and emotional states, and whose ideas of right and wrong differ from those of society in general.

(2) Those termed the passional criminals, who commit crime under the influence of passion, because of the weakness of the will, a deficiency in the power of inhibition.

(3) The criminal from chance, who is a feeble-minded person and therefore of defective judgment and inhibitory power, and is easily influenced by suggestions of a criminal character. Closely allied to the chance criminal is the criminal from habit, whose career is the result of association and environment. This class of criminals are known to prison officials as "repeaters," as they are likely to commit crimes similar in character with each succeeding offence.

Finally, the morbid criminal is the one with a well-defined psychosis, such as in the paranoid states, epileptic psychoses, drug addiction or dipsomania, and the large class of offenders who belong to the borderline class, which furnishes the most difficult of all classes with which to justly deal, as their mental states are not clearly defined. These have been designated as the "constitutionally inferior" class.

The modern conception of the relation between crime and mental inferiority has led to the practice of subjecting the accused to medical examination, especially of juvenile offenders, before the Court decided as to what disposal shall be made of such cases.

Consanguinity.—The intermarriage of near relatives has long been considered as a causative factor in the production of mental defects and disorders, and more especially of idiocy and deaf-mutism. The heredity

charts among defectives show many consanguineous marriages. Consanguinity acts to compound the force of heredity; the danger arises not from mere consanguinity, but from the fact that near kin, who are apt to resemble one another anatomically and physiologically, transmit these likenesses together with the neuroses already inherited by the progenitors. Among the Eskimos of North Greenland, living within an area of 250 miles, who have intermarried for years, imbecility and congenital physical defects are almost unknown for the reason that the ancestors were likewise free from defect.

In several insular and peninsular regions, where consanguineous marriages are common among defectives, investigation has revealed the occurrence of many examples of inherited physical and mental defects and disorders. Of the physical defects may be mentioned cerebral palsy of childhood, hereditary ataxia, retinitis-pigmentosa, otosclerosis, deaf-mutism, icthyosis, Thomsen's disease (muscular atony), albinism, night-blindness and color-blindness.

Furthermore the predisposition or tendency which appears to be transmitted from progenitors to offspring is a negative element, and is to be regarded as the result of the *absence* of certain qualities, rather than the presence of a something, which predisposes the individual to certain pathologic states. The incidence of physical disorder which we call diseases and anomalies, in several members of a family, indicates that something has failed to appear in affected individuals. In the instance of mental disorder, the abnormal condition arises because those persons have not inherited that which is necessary for the continued normal operation of the nervous mechanism in the presence of disturbing factors, or they lack something which in the normal counteracts the ill effects of operating causes.

The normal nervous system may be regarded as a dominant characteristic and the defective nervous system may be therefore considered as a recessive characteristic, just as pigmentation of the iris is due to the presence of a given characteristic and is dominant, while the absence of pigment in light-colored irides is due to the lack of a given characteristic and therefore is recessive.

The great variation in the percentage estimates of the relation between mental disorders and neurotic heritage gives rise to the question as to the reason which may be given to account for the apparent discrepancies among statistics. Heredity percentage statistics are made chiefly from data obtained from the relatives and friends of patients in the large public institutions. In many instances it is hard to get reliable information. The principal reasons for this are, first, actual ignorance of the facts and their importance on the part of the informants; second, the belief which prevails among many persons, that to be a member of a family in which there is the "taint" of mental affection is a disgrace, so that there is a strong tendency to conceal some of the facts. Statistics do teach,

however, that the percentage of instances in which neurotic heredity appears as a factor increases in proportion with the correctness of the information. In general, it may be said that in many instances the percentages are too low rather than too great. When the ideas of the public can be corrected concerning the fallaciousness of this belief, it can be hoped that statistics will be available which will be a step of greater value in the study of etiology, and still more important, the prevention of mental disorders. This, in return, will naturally react to the benefit of individuals who are strongly predisposed on account of heredity.

Biological Causes other than Heredity.—*Age.*—Certain periods of life appear particularly favorable for the development of mental disorders. Middle life furnishes by far the majority of instances, and also the greatest number of varieties of psychoses. At this time mental development has been completed and typical reactions are thus made possible. In hospitals there are usually found more patients between the ages of thirty and fifty than any other age periods. Exclusive of idiocy, mental disorder is extremely rare in infancy, although several cases have been recorded. Rush observed an instance occurring in a child of two years of age; Paul Rasmus reported a psychosis in a child of one year and nine months; Liebers reported a boy of five years, and Merin an acute case in a child of nine years.[11] Infants may show their nervous instability by an unusual susceptibility to delirium with the occurrence of febrile and digestive (toxic) disorders, by attacks of "night horrors," and later in childhood, by "sleep-walking."

At puberty or just before it, mental aberration is more common. Numerous instances have been reported, and recently by Drysdale, who believes acute psychoses are more common between the ages of ten and sixteen. The record describes the case of an apparently normal boy of eleven years who developed a maniacal attack and recovered after about three months, remaining seemingly well after a period of about two years. Certain mental changes are looked for in normal boys and girls, incident to the physiological changes of pubescence. This is shown by a certain degree of dulness or listlessness with more or less increase in irritability and peevishness. The condition normally goes no further than this, and in due time the mental characteristics become moulded into those of a mental adolescence. Dementia præcox develops in rare instances before pubescence. The period of adolescence, usually estimated as from fourteen to twenty-five years, which varies with the individual, is a critical period, especially for those who by reason of heredity are predisposed to nervous affections. It is during this period that the majority of precocious dementias (dementia præcox) develop.

In the climacteric, the period in which, to both men and women, serious somatic changes occur, mental disorders are very common, especially in women. It is at this time that the symptom-complex known ordinarily as "melancholia" is apt to develop, although any form of affective psychosis may occur.

Old age with its accompanying vascular changes and accidents to the cerebral circulation, especially hemorrhage and thrombosis, contributes the large number of " organic dementias." True senile dementia occurs without gross focal lesions and is rather the accompaniment of general atrophy, involving the cerebral cortical elements. Acute recoverable psychoses do appear in the sixth and seventh decades.

Sex.—Some statistics seem to show at first sight that there are more women than men affected with mental disorders. This is more apparent than real, for several reasons. The age incidence is earlier in women, especially those who are children of parents who have suffered from psychoses. These are apt to have recurrences and may be admitted several times to the same institution, thus swelling the list of female admissions. Women live longer than men in institutions, hence the accumulation of female chronic cases is apt to be greater. The death rate among males is greater as shown by the census of 1910 for the United States. The total number of patients admitted to hospitals " included 34,116 males and 26,653 females. Male patients are therefore in the majority; they are also in the majority in the population of the United States, but not in so marked a degree. In the total population there are 106 males to 100 females. In institutions for the insane the ratio is 110.8 to 100, and among the admissions to such institutions it is still higher, being 128 to 100. This means, of course, that in proportion more males are committed as insane." [12]

Environmental Causes.—Just as in the normal, both hereditary and environmental influences are necessary factors in the production of structural deviations and disturbances of function.

The study of the relationship which exists between the two sets of factors is important, in order to comprehend the influence of both the intrinsic and extrinsic factors.

Certain potential qualities are inherent in the germ for the development of an organism, but the organism would never develop if it were not for the influence of certain environmental factors.

Physical and chemical stimuli of various kinds applied to developing germ-cells give rise to more or less similar effects, as has been demonstrated by artificial parthenogenesis. Furthermore, these stimuli applied under favorable conditions give rise to certain developmental responses on the part of the germ-cell, both before and after fertilization. The effect of alcohol upon the germ-cell and ultimately upon the offspring is an important example. The effect in the production of defective and abnormal offspring, although as yet not definitely proved, is primarily the result of an alteration of the environment of the germ-cells, and secondarily an interference with the function of the germ, namely, the production of the normal type of organization.

Certain environmental stimuli such as the centrifugalization of eggs have been shown by Conklin to produce abnormalities of development. Stockard [5] and others have produced monsters by the

addition of chemical substances to the medium in which the animals are developing. Cyclopian monsters were produced in developing fish by treatment with magnesium, alcohol, and ether. Werber has produced similar results using solutions of butyric acid, acetone and urea.

The functional activity of organs exerts an important influence upon the development of the organs, and upon the organism as a whole. These activities, however, must be normally correlated in order that normal development may be the result. These and many other factors of environment influence the developing organism before its contact with the environment of the world external to the soma.

This phase of environment at once assumes gigantic proportions, and of man's environment it must be said that it is the most complex and variable of all animals and therefore its influence upon development is correspondingly greater. The importance of heredity as a factor has not increased for man in the same proportion as the environment, hence "the relative importance of heredity and environment is not the same in the development of an intelligent and social being, like man of the present age." (Conklin.)

Civilization and education in the broadest meaning of the terms constitute the complex part of environment. The early years of the life of human beings constitute part of the developmental period; in fact, this period in man is longer than that of any other animal, and hence the opportunity for the influence of environment is accordingly greater.

The effect of civilization, education and other environmental influences upon the occurrence of mental disorders leads into many channels, speculative and otherwise, and therefore cannot be generally discussed in these limits. Some of the fundamental aspects of the subject cannot be properly omitted.

Whether or not mental disease occurs among the uncivilized races is difficult to determine on account of the obstacles present in attempting to detect it. Macpherson says, "When a savage race comes in contact with modern civilization, insanity increases rapidly." Before the abolition of slavery, mental disorder was far less common than it is to-day among the negroes. There has been a steady increase with each decade, so that now apparently the proportion is as great in the colored as in the white races in this country. This fact is believed to be due to the increased mental stress associated with the responsibility of gaining a livelihood, the opportunity for indulgence in alcohol and other excesses and the greater chance for syphilitic infection.

Concerning the matter of education, there seems to be no room for doubt that too great pressure in early life acts deleteriously upon the mental organization of some individuals. The child conspicuously brilliant is by all means the one that should be carefully guarded in its early years, lest mental development be favored at the expense of physi-

cal powers. Inasmuch as this very brilliancy may be a sign of nervous instability, and should be regarded as an indication for holding back the pupil; the forcing of such a child to pass examinations in competition is a dangerous procedure. Too early maturation of mental powers is often a danger signal.

Pathologists recognize the instability of young, rapidly growing tissue cells, shown in their tendency to early degeneration. This seems likewise true of the stability cells of nerve tissue; early maturity means possible early decay; proper maturation and normal stability require slow and steady developmental growth.

In a given case of definitely known or suspected neurotic tendency, it will be of greatest importance to carefully guard the educational process of the child, especially in its earlier years. If such were carried out, parents might be spared in some instances the terrible experience of witnessing a child with brilliant prospects transformed into a being with blighted intellect.

Persons taking up an abode in foreign lands, or moving from rural to urban districts, in fact, any abrupt change in mode of living and change of environment may be attended with danger, and may furnish one of the causal factors of psychoses among those predisposed.

Occupation.—Certain occupations are known to favor the occurrence of psychoses, especially occupations in which the employed are required to live unnatural lives of exposure to influences which are physically unhealthful. This includes those exposed to the effects of toxic agents, such as lead, phosphorus, methylated spirits, and carbon monoxide, as in laundry workers; those whose occupations offer special temptations and opportunities for contracting vicious habits, for example, liquor dealers and commercial travelers; also those subjected to mental strain or excitement, for example, bankers, brokers, and railroad men. The latter class is said to furnish a large number of paretics.

Race.—Some investigators believe that certain races are more prone to mental stability than others; also that some types of psychoses occur more commonly in some races than in others. The bulk of evidence seems to point to the conclusion that race peculiarities alone are not sufficient to act strongly in the production of mental disorder, or even of a distinct variety of mental diseases.

Travelers in Africa have noted the rarity of psychoses among the uncivilized, also that among the savage races those who are weak in body and mind are not carefully guarded as in the civilized countries, but, on the contrary, are left to perish for want of attention, if not actually destroyed. This greatly lessens the possibility of the hereditary transmission as well as the actual number of existing defectives.

Again, although drunkenness is common, mental disease rarely is seen; this is largely due to the fact that those people do not obtain alcoholic beverages in sufficient quantity to allow the toxic effects to remain

long enough to produce permanent change in the nervous tissue, and also it is probable that by reason of the absence of the complex development of the brain itself, which has comparatively little psychic function to perform, alcohol is less likely to produce serious derangement.[7]

Previous Attack.—Among the predisposing causes one attack is believed to favor subsequent attacks on the ground that a state of lowered resistance is brought about by the attack, leaving the individual liable to subsequent psychoses. Naturally, in persons otherwise predisposed, should there be a recurrence of the same, or equally severe physical or mental strain, such as accompanied the first attack, the liability to a recurrence of mental disorder would still exist. The very fact that the patient has suffered one attack indicates a prepared state of the nervous system, either inherited or acquired. As many of the predispositions, if not all, are inherited, the necessary preparedness exists potentially, but requires an adequate exciting factor, great or small as the case may be. This is especially true in certain forms of disorder termed manic-depressive psychoses; one attack practically always speaks for another. In this type of disorder recurrence is an indication of a strong predisposition, and it is usually only a matter of time for the occurrence of some superadded causative factor to precipitate an attack.

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CHAPTER VII

EXCITING CAUSES

From what has thus far been stated, it will be assumed that mental disorders occur in individuals who are predisposed. A superadded disturbance which will so alter the normal action of the organ of adjustment may be the immediate or essential factor in the etiology of the mental disorder, which will be either temporary or permanent, according to its effect upon the nervous and mental organization.

The exciting causes may be divided into two groups: (1) those in which the influence is primarily physical; (2) those in which some psychic factor plays a conspicuous part, apparently to the exclusion of other causes. Such are the psychic or so-called moral causes. The second class of factors is more often in reality one of the means by which the evidence of the existing predisposition is furnished.

Physical Causes.—The physical causative agents are numerous and varied in character. They may be classified as the toxic, exhaustive, organic and traumatic. The number of subgroups under these heads is almost as great as the number of disease classes themselves, so that a consideration of the causes from a clinical rather than a pathological standpoint will be found convenient.

Infection and Exhaustion.—In the course of diseases of an infectious character, mental symptoms may appear either as a direct effect of fever, or as a result of the toxins of the disease. In some instances there seems to be a direct relation between the severity of the mental disturbance and the height of the temperature curve. In other instances, the symptoms do not appear until later in the course of the infection and continue irrespective of the fever. The infectious diseases with which psychoses are apt to be associated are typhoid fever, influenza, pneumonia, erysipelas and other exanthemata. There is, however, no type of mental disorder to correspond with a particular infectious disease, although the psychoses are often spoken of as post-typhoidal psychoses, pneumonic delirium, influenzal confusion and the like.

The mechanism by which infection operates in the production of psychoses is not always the same. In a few instances only is the disturbance from the reaction the direct effect of infectious organisms upon the nervous structures, for example, in rabies, sleeping sickness, paresis and possibly influenza. The toxic effect upon non-nervous structures is frequently more important than the lesions produced directly by an invasion of the nervous tissues. The question as to whether such lesions are primary or secondary remains unsettled.

True infective psychoses may occur during the course of the infectious disease or during convalescence, or may appear after the period of infection has passed, at the time when secondary toxins (proteids) have been formed as the result of disturbances of metabolism, and pathologic alterations of viscera with consequent disturbance of their functions. Similarly toxic conditions may arise as a result of states of inanition and exhaustion. Sometimes infections are active only in so far that they give rise to weakness or diminished resistance, which is favorable to the development of psychosis provided other acting causes are presented; in other instances it may be purely a matter of the direct or indirect action of toxins upon a predisposed soil.

Again, mental disease may appear many years after the symptoms of the infection have apparently disappeared, as in the instance of paresis after syphilis. In this instance the nervous system seems to offer, for a time, a comparatively greater degree of resistance to the treponemes; also the alteration which takes place in the nervous tissues is apparently one of residual change which requires considerable time before the effects upon the nervous system become manifest.

Infections may damage other viscera to the extent that a number of indirect attacks upon the nervous tissue may follow. Most of the lesions of the glandular organs depend upon infectious alterations of the blood-vessels.

Exhaustion.—It is important with respect to the part played by exhaustion in the psychoses to differentiate exhaustion from fatigue. Exhaustion is the effect of interference of function as the result of the influence of accumulated waste products formed in the tissue during activity. Fatigue is a natural result of functional activity, and is a condition which disappears as soon as the products of activity are removed. In exhaustion states accumulated waste products act as impediments to activity of the cells in which they originate; for example, such as accumulate in muscle cells and through the medium of the circulation are carried to the nervous tissues upon which these products act as toxins.

According to Verworn, the excitability of cellular substance is dependent upon the presence of oxygen in the molecules of "biogene" in the protoplasm. Cellular activity is the process of internal oxidation, a combination of oxygen with certain hydrocarbon compounds and their subsequent separation from the molecule of biogene. The loss which the cell suffers by this phenomenon is promptly made up by a fresh supply of oxygen and hydrocarbon groups to the molecule which renders it capable of other functional cleavages. If for any reason the supply of oxygen is stopped, cellular reaction continues until the store is exhausted, and in the instance of nerve protoplasm, the excitability is lost. Verworn applies the term "exhaustion" to the condition characterized by an inability on the part of the cell to continue in reaction.

Organs which are anatomically and functionally normal, and in

which metabolism is carried on normally, are not likely to be morbidly affected by simple excess of function. The tissues of the nervous system are especially resistant to the effects of inanition, so that we must look for the compensatory loss somewhere else than in a simple deficiency in food supply.

Exhaustive states occur as a sequence to disease in which intoxication is a prominent clinical factor. Among these may be mentioned infections, intoxications (exogenous), fevers, inanition, insomnia, visceral lesions and overaction of nervous elements in response to toxic stimuli (Lugaro). States of exhaustion are not infrequently an accompaniment of overwork associated with ill health and mental stress; after such exhausting conditions as are produced by acute diseases, loss of blood, pregnancy and parturition; also serious nervous manifestations are met among soldiers after exhaustion from long marches. Such states of exhaustion may affect the nervous system so profoundly as to give rise to a "collapse delirium." The frequency with which mental disorders accompany or follow the period of gestation has given rise to the use of the terms "psychoses of pregnancy" and "puerperal psychoses," and among other writers under the name "puerperal mania" on account of the frequency of clinical picture of mania. It should be understood that no particular type of psychosis is characteristic of the puerperal mental disorder. With regard to the exciting cause, in puerperal cases, doubtless some are septic, but in most cases the mental symptoms are to be attributed to states of exhaustion following labor. When the mental aberration appears, several weeks after delivery, the term "lactational psychosis" is sometimes applied, but the tendency is to include both classes under one group.

It will be seen from the foregoing that in many exhaustion psychoses it will be difficult to exclude the element of infection as a possible factor; in psychoses following prolonged illness it cannot be accurately determined whether the psychosis is the result of disease toxins or is due to the state of exhaustion in which the disease leaves the patient. The disorders of the mind which follow the infectious diseases often appear to bear the same clinical relation to the infection as that observed in the neuritic and other paralyses which follow diphtheria. Some mental disorders may follow upon infectious disease more or less closely and yet bear no relation to the toxins of the diseases, but are rather developed upon a favorable basis furnished by the exhaustive state, as is seen in the instances in which dementia præcox appears to have its beginning with the termination of an attack of typhoid fever or other acute febrile disease.

Comparatively few forms of mental disorder are the result of causes acting directly and exclusively upon the cerebral substance. The few classes are included under injuries, tumors, inflammations and parasites. Diffuse inflammatory processes are more often rather the residua of general disease conditions, toxic or infectious, which

exert their greatest influence upon the cerebral and other nervous structures, for example, the cerebropathies of childhood with the resulting destruction of cortical tissue by the blocking or rupture of blood-vessels. In adults, lesions that are of vascular origin are either the result of injury to vessels supplying the cortex or other brain structures, or are the result of blood-vessel wall diseases, and is the same pathological process frequently found in other parts of the body at the same time.

Focal Infections.—The rôle of focal infections as factors in the production of mental disorders has become the subject of active interest during the past few years. As already noted, the influence of disease toxins in producing psychoses is not to be questioned; but, whether long standing focal infections, such as may be produced by abscessed teeth and tonsilar affections, or infections of bony sinuses, the vermiform appendix and the gall-bladder are to be regarded in the light of being more than contributing factors, is yet to be established.

Cotton has isolated an organism described as the *streptococcus viridans* from tonsils and alveolai abscesses, among patients suffering from various types of mental disorder, namely, some of the acute confusional psychoses, others suggesting the symptomatology of paresis, and still others resembling dementia præcox.

It is quite reasonable to assume that focal infections may act as important contributing factors in the reduction of the state of the patient's general health, thereby diminishing the resistance to other contributing factors which may be active in the production of morbid mental states.

It is reasonable also to conclude that a focal infection becoming general, producing septicæmia and new foci of infection may give rise to mental symptoms.

On this basis the examination of the patient from the standpoint of infectious processes should be made in the search for causative agents.

Toxic Causes.—Considered in the broadest sense the toxic group of causal factors would include some of the etiologic factors discussed under the head of infections. On account of the fact, however, that a comparatively large number of psychoses arise from the use of drugs, the term "toxic" is here applied to psychoses arising from toxic substances taken into the body, and are usually known as "exogenous intoxications." Only in instances in which the intoxicating substance is ingested in large quantities at a single dose, or several successive doses, do we meet with the symptoms of an acute intoxication, the symptoms of which are due to the direct action of the poison on the nervous system. When the intoxication is habitual, that is to say, chronic, the action of the poison plays a part which, from the standpoint of the symptoms, is of secondary importance. Thus the continued use of alcohol in large amounts

produces disordered functions of the stomach, liver, kidneys and other viscera, and by default of these functions there are produced other toxins which in turn affect the functional activity of the nervous system. Furthermore, the prolonged action of toxic substances can determine processes which may progress independently of the action of the poison; for example, the degeneration of the neuronic elements and the proliferation of neuroglia. Acute intoxications may initiate disease processes which may either remain stationary or may become progressive.

Of the exogenous toxic substances, alcohol has the first place in order of frequency, and acts not only as a direct cause of mental disorders but also as an indirect agent. In making any estimate as to the number of instances in which alcohol is the etiological factor, care must be taken to consider the fact that many individuals become alcoholic because they are neurotics. The same predisposition enters as a factor in the production of alcoholism as it does in the occurrence of the psychosis. Morphin and cocain give rise to intoxications and mental disorders that are similar clinically; not infrequently these drugs are taken with alcohol. When not complicated with alcohol, drug habits are often brought about through the primary use of the drugs for medicinal purposes prescribed for the relief of pain. Chronic lead poisoning produces the train of symptoms included under the term "lead encephalopathy." Lead poisoning usually produces nephritis, which may be, in part at least, accountable for the nervous symptoms (uremia). Other poisons which may act as causal factors in mental aberration are santonin, atropin, chloroform, and ergot, the latter being comparatively rare in this country.

Autointoxications.—In the healthy individual there is maintained a complete balance between the repair and waste products which may be expressed in terms of nitrogen, the characteristic element of the principal foodstuffs. By reason of changes in the individual's environment, the character and amount of food, the amount of energy expended and other variable factors, there is required a certain degree of adaptability in order to maintain the normal balance of nutrition. If for any reason that balance is lost for a considerable period, all of the cells of the body suffer in consequence. If the nervous system suffers conspicuously, the reaction is manifested by such symptoms as increased nervous irritability and susceptibility to fatigue, or "nervous exhaustion."

Much attention had been given to the subject of autointoxication since Bouchard, in 1887, furnished the impetus to study of the subject. Forcheimer[1] analyzed 77 cases of autointoxication due to gastrointestinal disturbances and found "nervous symptoms" in 61 patients, shown by attacks of genuine migraine, headaches, neuralgia, neuritis, general nervousness, restlessness, irritability, insomnia, mental depression, and hysterical attacks. It is a matter of common observation in clinical experience to note marked defects in functional activity of the

stomach and intestines in both acute and chronic forms of mental disorders. These disturbances of digestive function may be either exciting causes of the mental disturbance or merely part of the symptom-complex.

The Internal Secretions.—The reactions of the individual are controlled and correlated as the result of the coördination of bodily functions through the medium of the nervous system. This is the basis of the control of those functions which are required to be brought into a state of activity promptly in order to make proper adjustments to environmental changes.

The bodily functions, on account of their very nature and the fact that they are slower in their action, for example, the movements of the digestive apparatus and the physico-chemical changes of the metabolic processes, are controlled through the medium of the blood, and are *activated* by the chemical substances known as the internal secretions.

Under critical conditions, as in times of great demand for additional energy, these chemical substances may be called upon to aid the nervous system, or the nervous system may influence increased production of these substances, by influencing the activity of the glands supplying the secretions, to further prepare the body for emergencies (see Internal Secretions and Emotions); for example, the effect of adrenin upon muscles and glands is the same as that which is produced by stimulation of the sympathetic nerve supply.

The disorders of the nervous functions associated with the internal secretions may be dependent upon deficiency or an increase in the amount of the secretion supplied, which, on account of its presence in the blood, may disturb nervous equilibrium. On the other hand, disordered nervous function may interfere with the normal output of the internal secretions, which in turn may interfere with nervous function, thus establishing a vicious circle.

Defective and Disordered Glandular Activity.[3]—The effects of disordered glandular activity are especially well marked in the instances of hypothyroidism and hyperthyroidism. When congenitally absent or deficient cretinism is the result; if the thyroid gland is removed later in life, or if sufficiently deficient functionally from disease, myxedema follows with its train of nervous and mental symptoms. In exophthalmic goitre there is an hypertrophy of the glandular structure, and commonly a train of nervous symptoms with it. In fact, the majority of patients suffering from Graves's disease present mental symptoms in some degree, usually in the form of an intense and indefinite agitation, with mental and motor restlessness. Severer cases suffer with marked mental excitement, restlessness, sleeplessness, incoherence and violence, refusal of food, emaciation, diarrhœa, exhaustion and death. The symptoms of Graves's disease are the antitheses of those found associated with deficiency in thyroid secretion, and correspond rather with the symptoms

which follow the administration of the glandular extract in full doses. Comparing the two conditions, it is noted that in myxedema there is a slow pulse; the skin is dry, cold and thick; and there is slowness with dullness of the mental processes. In Graves's disease there is rapid action of the heart; the skin is apt to be moist, warm and thin; and there is increased mental excitability with a tendency to irritability. An instance of a psychosis appearing in a patient in whom a partial thyroidectomy had been performed with relief from the hyperthyroid symptoms was observed by the writer.[2] The clinical course of the disorder was that of an acute exhaustive psychosis, which followed upon a severe infection, and terminated in physical recovery and mental restoration. The *parathyroid glandules* were formerly considered to be supplementary to the thyroid, capable of entering upon functional activity in case of lesion of the thyroid. The function of the thyroid is now regarded as trophic and that of the parathyroids as antitoxic. Removal of the thyroid causes serious disturbances in the adult, and arrested development in young subjects. When the parathyroids are removed or their blood supply interrupted, death follows shortly with symptoms of muscular tetany and acute intoxication. The condition thus induced in animals can be removed by the injection of calcium salts. The opinion that the function of these glands is in some way related to that of the thyroid is still generally recognized. Whether they play any part in the disturbances of faulty thyroid secretion is yet to be determined.

The *adrenal organs* have recently attracted attention in the matter of the study of their effect in the production of abnormal variations in blood-pressure. Repeated injections of adrenalin have been shown to be followed by structural changes in the walls of the arteries. The problem connected with this fact which interests the pathologist is the possibility of the correlation between overaction of the adrenals and arteriosclerosis with its accompanying high blood-pressure. In senile and presenile conditions and the accompanying anatomical changes, it appears that the involution of the genital organs is accompanied by an excessive adrenal activity. The interrelation between these facts has not been proved and therefore serves only as an attempt at an explanation of the presence of arteriosclerosis and the psychoses occurring in the involutive period of life. More direct evidence has been produced by the result of the studies in connection with the adrenal secretion and the emotional states by Cannon and his coworkers. The interrelation between the adrenals, carbohydrate release and the sympathetic nervous system has been definitely determined experimentally and has been shown to enter into the chain of defensive and adaptive reactions in the adjustments of the organism (see Adrenals and Emotional States, p. 95).

The removal and destruction by disease of the *sexual glands* have long been recognized as capable of producing changes both mental and physical. It is well known that when an artificial menopause has been

brought about by the removal of the ovaries, distressing mental and physical symptoms are sometimes produced, which can be alleviated by the administration of ovarian extracts. These changes are considered to be the result of the internal secretion of the glands furnished not by the sexual elements, but by the interstitial cells of the sex-glands. The changes incident to sexual puberty would seem in the light of recent researches to bear some relation to this internal secretion. The so-called " secondary sexual characteristics " which form the distinctive features separating male from female, depend upon the action of the internal secretions from the sex-glands, and which may either serve to stimulate or inhibit the development of the characters, such as in the male fowl, the larger size of body, the comb, and spurs. If the ovaries are removed from a pullet she develops the secondary characters of the cock. Some mammals when unsexed usually remain infantile. The transplantation of ovarian substance under the skin of a castrated male guinea-pig is followed by the development of some of the secondary characteristics of the female, *e.g.,* the development of the mammary glands.

The *pineal body* is a gland which undergoes involution after puberty, the glandular substance being replaced by fibrous and calcareous materials. The gland reaches its highest development at about the seventh year. In young individuals disease of the pineal body is accompanied by an accelerated development of the sexual organs and the skeleton, together with mental precocity.

The *pituitary body* is now accepted generally as having an important influence upon metabolism. Deficiency of the gland is accompanied by hypertrophy of the thyroid and medullary part of the adrenals, persistent thymus and atrophy of the sexual glands. It affects the secretion of urine and milk, and the carbohydrate metabolism correlated with the other ductless glands. Injections of the extracts of the posterior lobe of the gland cause glycosuria by the production of a carbohydrate intolerance. Insufficient secretion leads to an increased sugar tolerance, and sexual development is arrested.

The activities of these glandular structures are regarded as essential to the normal economy either by supplying a material (secretion), which is believed to enter the lymphatic and thence to the blood-stream, and which are utilized by special organs, or which act in such a way as to neutralize or destroy substances which, when present, interfere with the function of other viscera. Chemical products which stimulate the activity of special organs are termed " hormones."

Pathologic physiology has not determined to what extent disordered function of the organs of " internal secretion " affects the activity of other viscera, but it is probable that, either by reason of a lack or superabundance of one secretion poured into the lymphatic system, the nervous apparatus, may be affected, directly or indirectly, through interference with the functions of other viscera.

The recent application of the principles of the " defensive ferments " as suggested by Abderhalden has given, in the hands of some workers, results which are strongly indicative of a pluriglandular dysfunction in some psychoses. On this basis has been constructed an hypothesis which considers that, in dementia præcox especially, there is induced a toxemic state which is responsible for many of the symptoms. Studies of the blood-serum reactions with the glands of internal secretion, including the sexual glands, especially the latter, together with one or more of the former, result in reactions which point to the presence of defensive ferments against the proteid substances of these organs.

Disease Toxins—Syphilis, Tuberculosis.—Among the chronic infections syphilis stands foremost in the line of importance in regard to the etiology of mental disorders as an exciting factor. The severity of the primary disease appears to bear no direct relationship to the nature of the secondary mental disorder. From the syphilitic psychoses are excluded those cases of mental disturbance which arise as the result of the direct alteration or destruction of nervous tissue such as occurs in instances of gummata, meningitis and endarteritis; these are properly organic brain diseases, and will be considered under that caption.

In some persons of unstable nervous constitution the effect of a syphilitic infection may be manifested by the accompaniment of nervous and mental disturbances. The initial syphilitic fever is at times accompanied by a delirium similar to the febrile delirium of other infections of a more acute type. Furthermore, neuropathic persons who have been exposed to the risk of infection, or may have actually become infected, suffer from a profound moral or emotional effect as the result of the psychic shock. This may be so marked as to give rise to morbid mental states in which fear is the predominant element in the individual's mind. The patient who fears that he has contracted the disease commonly consults one physician after another, but is unable to be assured, although no symptoms can be found. Occasionally it is possible to satisfy the patient that he is free from the disease, but in a short time his doubts again become uppermost in his mind, and the phobia returns as strongly founded as before. In persons actually infected the fear may be so strong as to interfere with the patient's ordinary duties and pursuits. On account of the dread of contaminating whatever he may touch, the patient may spend a large part of the time washing his hands because of the fear of infecting other persons. This abnormal fear of syphilitic infection, or concerning its results, has been termed " syphilophobia." In instances in which there exists a psychosis non-syphilitic in origin in an individual who has had syphilis, the fact that there has been a previous infection known to the patient may add color to delusive ideas. Two patients in the writer's experience, one infected more than twenty years, and the other ten years, before the appearance of the psychosis, that of a depressive type in both instances, were dominated by the idea that they would similarly infect other per-

sons about them. Again, the constitutional effects of syphilitic infection may produce profound nutritional disturbances as are shown by a distinct cachexia, confusional and stuporous states; more rarely delirium may appear.

Since the demonstration of the presence of the organism of syphilis in the brains of patients dying from paresis, the relation of the two diseases has become well established. The question as to whether syphilis and predisposition are the only etiologic factors is as yet an open one. The matter will be discussed further under the description of paresis (Chap. III, Part II).

Organic Cerebral Disease.—Psychoses arising from "coarse brain disease" may occur as an accompaniment of multiple sclerosis, meningitis, embolism, thromboses, brain atrophy, tumor and abscess, parasites, and the effects of head injury. Mental symptoms commonly appear as part of the terminal condition. All of these affect directly the cerebral substance, but only the last three named affect the brain exclusively. The lesions of gross syphilitic brain disease may be either diffuse or localized and may vary in extent from an endarteritis to tumors of large proportions. The mental symptoms may occur at any time after the initial lesion. Any of the organic brain diseases characterized by alteration of the nervous structural elements may be the residue of general processes—toxic or infective—arising externally to the nervous tissue.

Chronic Diseases not Primarily of the Nervous System.—By lowering the resistance of the nervous system in persons predisposed, non-nervous diseases may act as important factors in the etiology of the psychoses.

Prolonged anæmia, which has been known to be accompanied by certain types of degeneration of the neuronic elements, especially in the spinal cord, may also be associated with mental aberration. The psychic disturbance may be slight and shown by a state of simple mental apathy; or it may reach the more severe types of confusion and delirium. Similarly many of the cachexias may be accompanied by pronounced mental symptoms.

Gout.—Instances of mental disorder are commonly met in persons with a history of a gouty diathesis, and among patients in families whose members suffer from gout. Attacks of transitory mental disturbance follow exacerbations of the disease and in the course of gouty attacks, especially during marked rises in temperature. A patient in the writer's experience suffered three attacks of depression with prolonged attacks of gout. Active delirium is more rarely met and usually is of short duration, as is likewise true of gouty confusional states.

Diabetes.—Glycosuria is not infrequently found in patients suffering from chronic psychoses. In such instances the laboratory finding is either an accompaniment of the nervous disorder or may be due to degenerative changes incident to the nervous disorganization. The

mental disorders due directly to the complex disorder known as diabetes are of course toxic in origin. The writer observed in a patient, who suffered from the usual symptoms of diabetes mellitus for about eight years, an active hallucinosis which terminated in coma and death in a few days. When the mental symptoms appear in the course of the disease, the type is apt to be that of depression, together with a diminished capacity for mental work. This may gradually become more pronounced and result in permanent deterioration of the mental powers. Cases resembling paresis have been described, the symptoms disappearing with the subsidence of the glycosuria.

Traumatic Causes.—These include the accidental physical or surgical forms of shock which may disturb mental function more or less permanently. Many instances of mental disorder appear to follow closely upon an injury to the head, such as depressed fractures of the skull with brain injury. The mental symptoms may appear immediately after the injury has occurred, in which cases will be seen the clinical picture of the acute confusional psychoses. There may be a lapse of weeks, or even months, before the mental symptoms are marked, although during the interval there will have been prodromal signs. Meyer,[4] in a study of a series of 23 patients suffering from mental symptoms following head injury, concludes the following: "In nine, a fracture at the base is, to say the least, extremely probable or certain; a fracture of the convexity in five, and, at least, a more or less severe concussion in seven; one was due to a pistol shot, and one to an unknown trauma which left a scar on the forehead." There is always in such cases the question to be answered, "Would the patient have developed mental disorder without the injury?" as Meyer states it, and further adds, "We cannot fail to be impressed by the occurrence of several etiological factors in the greater majority. Even in the four cases which immediately followed the injury, constitutional peculiarity exists in two, and alcoholism in one." In the writer's experience by far the majority of mental disorders following head injury occurred in alcoholics. In addition, the fact had been conspicuously notable that after the injury the patient's tolerance for alcohol was greatly diminished.

Pychoses occurring after surgical operations are to be regarded, in many instances, as exhaustive psychoses, except those due to sepsis or the effect of the anæsthetic. Instability or diminished resistance to the physical shock and its mental effects is commonly shown by the appearance of mental disorder after an injury. A patient, who has suffered a fourth attack of manic-depressive psychosis, exhibited the initial symptoms in two attacks after a fracture at the wrist, and following a sprain of the ankle-joint. Another patient exhibited the initial symptoms of a prolonged attack of depression following an appendectomy, in spite of prompt and otherwise uneventful recovery from the surgical condition.

Insolation.—The mental symptoms accompanying sunstroke are pro-

duced as the result of meningitis, and resemble closely those of traumatism. If mental symptoms do not follow immediately upon sunstroke, the patient may be left in a state of lowered resistance, with impaired memory or other mental defect. Instances of paranoid states and paresis occurring in patients who have suffered one or more attacks of insolation only indicate the possibility of the effect of this factor in diminishing the stability of the nervous system in subjects already predisposed.

General Nervous Diseases.—The same predisposition which lays the foundation for a general nervous disorder, permits the development of mental symptoms with the physical nervous disorder, and may even form a conspicuous part of the disorder.

Epilepsy.—In instances in which neither the convulsive attacks nor the mental aberration can be regarded as the primary disorder are properly termed "epileptic psychoses," but both are equally the effect of the same cause. Most epileptics, if they live long enough, show some mental deterioration; this is especially the case in patients in whom the attacks began in early life. True epileptic psychoses present almost every degree of mental alteration, from the merest excess of irritability of temper to the most dangerous homicidal fury.

Hysteria.—The symptoms of hysteria are regarded as having a psychic origin, and it may be safely said that all hysterics present symptoms referable to disordered mental activity. Certainly hysteria is built upon a neuropathic foundation. The affection of the emotional attitude leads to the development of morbid fears and self-conscious states, with a marked weakening of the power of will or aboulia.

Chorea (Sydenham's) is usually accompanied, even in mild cases, by some change in the mental state, especially noticeable as a change of disposition. In children this is apt to be shown in the form of an unusual irritability and peevishness; in older patients there may be loss of power of attention and memory defect. In the majority of instances severer mental symptoms do not develop. Some patients, however, do exhibit graver mental disturbances with an hallucinatory or maniacal delirium. The symptoms fortunately usually disappear with the termination of the choreic state. The exciting cause of the mental symptoms is probably the same as that which produces the physical symptoms, and the accompanying psychosis properly belongs to the infective group of disorders, as is shown by the frequency of acute polyarthritis and endarteritis (see Choreic Psychoses, Chap. I, Part II).

Huntington's Chorea.—This, a much more serious malady, is an hereditary, degenerative, organic disease which shows a marked tendency to familial occurrence and practically always ends in dementia, provided that the patient lives long enough. The disease appears in adult life and gradually the physical and mental symptoms progress until the patient dies of exhaustion, or as the result of some intercurrent disease. On account of the pathological character of the disease it is classed among the organic dementias.

Traumatic Neuroses.—On account of the fact that nervous disorders occur following injuries, either slight or severe, when attended with shock, especially in railway accidents, explosions, earthquake, or electrical shock, or other accident in which a profound mental insult follows, mental symptoms are not uncommon. In addition to the physical exhaustion and motor symptoms, mental depression is sometimes present to a marked degree. One case of mild mania observed by the writer developed shortly after an experience in the San Francisco earthquake. As has been stated in the matter of the psychoses following head injuries, there is always a question as to how much depends upon the trauma and how much to the predisposition of the individual.

Paralysis Agitans.—Mental disorders associated with this disease may vary in type from a simple change in disposition or temperament to profound depression with suicidal tendencies. Most cases showing mental symptoms terminate in mental enfeeblement. Two patients who came under the observation of the writer, both of whom exhibited marked mental reduction, presented all the classic symptoms of Parkinson's disease except that of tremor.

Psychic Causes.—The more carefully one investigates the factors supposed to operate in the production of mental disorders exclusive of the psychoneuroses, through a direct action upon the mind, the less important do they appear to be. This is especially brought to the examiner's attention when an attempt is made to analyze their mode of action.

In individuals strongly predisposed, instances are met in which psychoses appear to have an onset immediately after an intense psychic impression. Such causal factors are sometimes spoken of as " emotional " or " moral causes," and are regarded as an index of nervous instability; the stronger the predisposition the less of an exciting stimulus is required. The effects of severe emotional impressions have been compared with that of physical trauma in the production of shock.

Emotions long continued may indirectly operate so as to lead to mental disorders. It has been pointed out that accompanying the complex of sensations which are called emotions, there are reactions on the part of the viscera, thus giving rise to the usual visible signs of the emotional state. Similarly, but by a prolonged process, the physical reactions which follow continued grief, care, worry and anxiety are shown in their effect upon the general health. The appetite, digestion and nutrition suffer in consequence; there is loss of sleep and commonly a lack of exercise; finally as a result of the combined effects of these factors the physical health is undermined and the psychosis appears. Lugaro suggests that through the disturbances of nutrition some autointoxications can be determined.

In attempting to determine the value of supposed causative factors it must be taken into account that there are usually several

agents to be considered. A number of cases of mental disorders are given the credit of being produced solely as the result of domestic or financial troubles, love affairs, or overwork and excessive worry. Relatives of patients, naturally, are prone to lay too much stress upon such factors. The better plan to follow is not to place too great importance upon any one possible causative agent in the production of the "abnormal departure" until all phases of the patient's life have been made the object of study.

In recent years there has been a tendency to consider certain psychoses as constituted of mental phenomena of the same nature, and marked by deviation along the same lines as the personal peculiarities which formed the natural make-up of the patient before the beginning of the psychosis; and, furthermore, that the psychosis is a further development or a continuation of that personality. According to Hoch,[5] the question in such instances resolves itself into the matter of determining whether or not the psychosis is colored by personality.

There is much in the make-up of the individuals who later develop dementia præcox to strengthen this argument; for example, the formation of bad mental habits and faulty adjustment to reality. Hoch states that in 50 to 60 per cent. of his patients the traits which had existed before the mental breakdown, which traits he called "shut-in" tendencies, were characterized by an absence of well-balanced mental attitudes.

Etiology of Psychoses—Summary

I. Predisposing causes:
   1. Heredity.
   2. Age—
      Infancy.
      Puberty.
      Adolescence.
      Climacteric.
      Senility.
   3. Sex.
   4. Education, including mental development and environment.
   5. Occupation.
   6. Previous attack.

II. Exciting causes:
   1. Physical—
      (*a*) Acute infectious diseases: Typhoid, influenza, smallpox, polyarthritis, malaria, focal infections.
      (*b*) Exhaustion: Mental and physical.
      (*c*) Intoxications: Alcohol, morphin, cocain, lead, carbon monoxide, mercury, chloral, atropin, ergot, pellagra.
      (*d*) Auto-intoxications: Gastro-intestinal, renal, hepatic.

Defective glandular secretion: thyroid, adrenal, pituitary, pineal.

(*e*) Chronic diseases: Anæmia and cachexias, heart and vascular disease, gout and rheumatism, nephritis. Chronic infections: Syphilis, tuberculosis, trypanosomiasis.

(*f*) Nervous diseases: Epilepsy, chorea, hysteria.

(*g*) Organic brain disease: Tumor, thrombosis, embolism, hemorrhage, abscess, meningitis.

(*h*) Pregnancy and lactation.

(*i*) Trauma and insolation.

2. Mental—
   1. Fright and nervous shock.
   2. Mental stress: Business reverses, domestic troubles, disappointment, love affairs, excitement, mental anxiety in general.

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CHAPTER VIII

CLASSIFICATION

THE necessity for classification makes itself apparent in the study of mental disorders, chiefly for the reason that several disease-forms seem, at first, to bear strong resemblances. In general pathology it is possible to classify diseases more or less definitely, according to the causes at work in the production of the abnormal condition. If the causes be unknown diseases may be classed according to the location, or the systems of organs affected, or, according to the character of the morbid process demonstrable by methods of anatomical examination. Thus infectious diseases of known origin, or of unknown origin, concerning which we possess sufficient data to prove their infectious character, constitute a clearly recognizable class. Other diseases naturally group themselves with respect to the systems of organs involved, as diseases of the vascular, respiratory, alimentary, genito-urinary and nervous systems. Again, if the view be taken from the point of anatomical change, such distinctions as inflammatory, degenerative, neoplastic, and so forth, may be made.

Pathologists have been endeavoring for years to find an entirely satisfactory classification of tumors. This has not been accomplished, and probably will not be until more is known concerning the etiology of growths, but the study of that chapter of morbid anatomy nevertheless continues progressively with the aim of gaining the desired knowledge.

No matter what method of classification be adopted, diseases and their morbid processes cannot be classed in a given category without falling into one or more other groups at the same time. This fact, however, does not destroy the identity of the disease, nor does it mean that nosologic confusion must follow. In mental diseases particularly this overlapping of classes is found to occur in any attempt to form groups or types of disorder. One of the simplest groupings of mental diseases is that used by Bianchi,[1] who states: "The first comprises the affections represented essentially by an evolutionary psycho-cerebral defect; a second group comprises all the mental affections of infective, auto-toxic, and toxic origin, developing in an individual regularly evolved; in the third group are included all the affections with organic substratum, localized or diffuse, in the central organ of mind." Bianchi further observes that these groups are not precisely distinguished from one another; that, for example, the infections and intoxications are not confined to the second group, but are found also in the first.

Changes leading to arrest of development may be of infective origin as in variola; or toxic, as in alcoholism in either parent, which in turn may produce an effect upon the evolutionary potential of the individual. Anatomical lesions are found in all three groups.

This overlapping of groups is not the sole barrier to unity in classification. The greatest difficulty lies in that in addition to the fact that we have to consider disease processes, we have to deal with individuals, each one of whom is the possessor of inborn characteristics which may modify the action of any operative causal factor. To return for a moment to the matter of general pathology as a parallel, no two individuals react in precisely the same manner to the infection of typhoid fever; much less do we find identical mental reactions to morbid influences upon the nervous system. Any attempt to classify mental disorders from the standpoint of pure symptomatology would be found to be about as difficult as it would be to classify human beings according to types of mind. Symptoms alone are of the same value in the determination of the type of mental disease that fever, pain, nausea, and other signs are in the diagnosis of physical disease.

Upon a basis of pathologic anatomy a classification of mental disorders is desirable, but has not been made on account of the fact that there is no known morbid anatomy of such disorders as hysteria, psychasthenia, the manic-depressive psychoses and paranoia. Furthermore, when more or less definite anatomical changes can be demonstrated in the brain substance, the problem is still far from solution. Similar pathological changes commonly give rise to dissimilar symptoms, and unlike morbid processes may give rise to similar symptoms-complexes in different persons.

With the increase in the number of points of view there have come into existence many classifications. Some of these differ considerably, others differ but little. From the one extreme of the nosologic nihilist who regards all mental disorders as one disease, and varying only as persons vary, to that of the other extreme viewpoint which inclines to the consideration of almost every symptom-complex as a clinical entity, there are several intermediate points of view.

The best classification, that is to say, the one which will give the student of psychiatry the best working basis, will be one that is founded upon pathologic anatomy as far as possible, together with symptomatology, and arranged in such a way as to include the greatest number of factors operative in the development of the disorder.[2]

This cannot be fully accomplished as yet, on account of the absence of certain essential data. The various types of disorder may be classified for convenience of study and the purposes of statistics (which are the real advantages of a classification) and arranged under the following groups with their subdivisions:

(1) Mental disorders with an organic substratum which show,

sooner or later, evidence of defective function of the organ of adjustment in the form of an irrecoverable mental loss; (2) a group which represents a **quantitative** disturbance of the normal mental processes, such as is seen in the manic and depressive psychoses, characterized in the one phase by a state of exaltation (mania) with rapid but coördinated flow of thought and increased motor activity; in a second phase characterized by mental depression, retardation of the rate of flow of ideas and marked motor sluggishness; (3) a group of disorders characterized by primary disturbance of the sensory (perceptive) sphere and consequent mental confusion, resulting in a **qualitative** disturbance of varying degrees of intensity.

All of these types of mental disorder represent the " reaction type " of an individual rather than that of a certain morbid category into which we place our patients.

Realizing the fact that from a purely scientific standpoint satisfactory classification of mental disorders cannot be made, whether it be from the standpoint of etiology, symptomatology, pathologic anatomy or psychology; and cognizant of the necessity of a uniform grouping of mental diseases for the purpose of statistics and reports of hospitals throughout the country, a classification proposed by the committee appointed by the American Medico-Psychological Association and accepted at its Session in 1917 is as follows: [3]

Proposed Classification of Mental Diseases *

1. Psychoses with somatic diseases.
   - (*a*) Delirium with infectious diseases.
   - (*b*) Post-infectious psychoses.
   - (*c*) Exhaustion delirium.
   - (*d*) Delirium of unknown origin.
   - (*e*) Diseases of the ductless glands.
   - (*f*) Cardiorenal disease.
   - (*g*) Cancer.
   - (*h*) Other diseases or conditions (to be specified).
2. Alcoholic psychoses.
   - (*a*) Pathological intoxication.
   - (*b*) Delirium tremens.
   - (*c*) Acute hallucinosis.
   - (*d*) Acute paranoid type.
   - (*e*) Korsakow's psychosis.
   - (*f*) Chronic hallucinosis.
   - (*g*) Chronic paranoid type.
   - (*h*) Alcoholic deterioration.
   - (*i*) Other types, acute or chronic.
3. Psychoses due to drugs and other exogenous toxins.

* The numerical order of some of the classes has been changed to conform more closely with the order in which these psychoses are discussed in the text.

(*a*) Morphin, cocain, bromides, chloral, etc., alone or combined (to be specified).
(*b*) Metals, as lead, arsenic, etc. (to be specified).
(*c*) Gases (to be specified).
(d) Other exogenous toxins (to be specified).

4. General paralysis.
5. Psychoses with cerebral arteriosclerosis.*
6. Psychoses with cerebral syphilis.
7. Psychoses with Huntington's chorea.
8. Psychoses with brain tumor.
9. Psychoses with other brain or nervous diseases.

The following are the more frequent diseases to be specified when possible:
Cerebral embolism.
Paralysis agitans.
Tubercular or other forms of meningitis (to be specified).
Multiple sclerosis.
Tabes.
Acute chorea.
Other conditions (to be specified).

10. Psychoses with pellagra.
11. Traumatic psychoses.
12. Dementia præcox.
    (*a*) Simple type.
    (*b*) Hebephrenic type.
    (*c*) Catatonic type.
    (*d*) Paranoid type.
13. Manic-depressive psychoses.
    (*a*) Manic type.
    (*b*) Depressive type.
    (*c*) Stupor.
    (*d*) Mixed type.
    (*e*) Circular type.
14. Involution melancholia.
15. Senile psychoses.
    (*a*) Simple deterioration.
    (*b*) Presbyophrenic type.
    (*c*) Delirious and confused states.
    (*d*) Depressed and agitated states in addition to deterioration.
    (*e*) Paranoid states in addition to deterioration.
16. Paranoia and paranoic conditions.
17. Psychoneuroses and neuroses.
    (*a*) Hysterical type.
    (*b*) Psychasthenic type.
    (*c*) Neurasthenic type.

* This includes psychoses following cerebral hemorrhage.

18. Psychoses with mental deficiency.
19. Psychoses with constitutional psychopathic inferiority.
20. Epileptic psychoses.
    (*a*) Deterioration.
    (*b*) Clouded states.
    (*c*) Other conditions (to be specified).
21. Undiagnosed psychoses.
22. Not insane.
    (*a*) Epilepsy without psychosis.
    (*b*) Alcoholism without psychosis.
    (*c*) Drug addiction without psychosis.
    (*d*) Constitutional psychopathic inferiority without psychosis.
    (*e*) Mental deficiency without psychosis.
    (*f*) Others (to be specified).

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CHAPTER IX

SYMPTOMATOLOGY

CLINICAL psychiatry is concerned with the study and interpretation of reaction types the conspicuous symptoms of which are manifested in the form of disordered mental operations, indicated by a change in the individual's "mode of feeling, thinking and acting."

The order in which these three mental operations occur normally is not infrequently the order in which they are involved in abnormal mental states. The term "feeling," for purposes of clinical description, is used in the broadest sense and includes every form of sensation and the accompanying effects upon the organism, all of which are included within the meaning of the term "emotional state." Feeling, then, practically, means *sensation* and *emotion*. It has been emphasized that all mental operations depend primarily upon the individual's experience with reference to the external world, considered from the standpoint of the nervous system, and that thoughts and actions are the end-products of sensory experiences.

The symptoms of mental disorders are those which follow a disturbance either functional or organic in some part of the nervous pathway extending from the periphery to those centres and pathways concerned in the mental processes.

Normal psychology studies in the course of its investigations, sensation, perception, emotion, volition and other mental processes. The study of psychiatry involves the consideration of the same mental processes which have become exaggerated or diminished in their capacity for action.

Observation of the actions of an individual leads to the formation of an opinion on the part of the observer with regard to the mental state of the person observed. This is made possible chiefly by the fact that mental states are accompanied by some form of motor activity. In some instances the motor element is so insignificant as to be noticed only by the trained observer, in others it is often so marked as to be quite apparent.[1]

In the observation of the symptoms of mental disorder one has to deal, just as with persons in health, with the various modes of gaining experience, which may be disordered quantitatively or qualitatively. As one cannot experience the actual perceptions or emotional states of another individual, mental processes in health and disease can only be observed directly by the person who experiences them.

One of the essentials in the analysis of the symptoms of mental disorder lies in the fact that it is necessary to estimate how much of the symptom-complex observed in the mentally sick man is due to

the disordered mental function, and how much is a part of the individual's normal reaction.

Normal individuals are able to exercise control over the motor accompaniment of thought processes, especially in the matter of speech, and therefore do not give expression to all thoughts. In mental disorders the patient still retains a certain amount of normal inhibition, which frequently may act as a barrier to examination. In other forms of disturbance, for example, in manic states, we find the loss of this inhibition a conspicuous symptom—the patient is obliged to say or give expression in speech or action to every thought which enters his mind.

As sensation and perception are fundamental processes in all mental operations, either present or remote, the symptoms of mental disorders can be conveniently considered beginning with the **disorders of sensation and the process of perception.**

The disorders of the sensory group of mental processes occur in the following forms :

1. Disorders of Sensation and the Process of Perception:
   - (a) Anomalies of perception (insufficiency).
   - (b) Illusions—falsified real perception.
   - (c) Hallucination—unreal perception.

From the neurologic standpoint the usual sensory disturbances occur as anæsthesia, paræsthesia, hyperæsthesia, hypæsthesia, described in terms of tactile, heat and cold, muscular, spacing (astereognostic) and the kinesthetic senses. Alterations of all these types of sensation occur as accompaniments of mental disorder, especially if associated with peripheral nerve disturbances. In these instances the patient reacts differently from persons similarly stimulated, who are not mentally disordered.

The tabetic patient, for example, experiences a "girdle sensation," but is readily convinced that there is no band about his waist. The person who in mental health falls asleep with his head resting on his arm in such a way as to produce pressure upon the musculo-spiral nerve, and who awakes with an unusual sensation of "pins and needles" in the arm and hand, realizes promptly that the sensation is an abnormal one, and employs measures to restore normal feeling in the affected member. In both these examples the disorder is entirely peripheral, and the disorder of sensation is realized by the patient. In the mentally sick these same disorders may be present, and not be recognized in their true relationship to facts. The same is true in the matter of cortical lesion, giving rise to sensory disturbances for which no mental correction is made.

Mental disorders are more frequently accompanied by sense deceptions without clinically demonstrable lesions either cortical or peripheral, and are dependent upon disturbances of the process of perception. These are termed hallucinations and may refer to any one of the special senses.

Disorders of Perception

Anomalies of perception may exist in the mentally defective from birth and are dependent upon deficiencies in development of structural nervous elements. The defect may be due to an insufficiency as to quality, or the number of structural elements may be insufficient, or there may be a deficiency in the chemical and structural make-up of the nervous elements of a peripheral organ. A common example of the latter occurs in color-blind individuals who are unable to differentiate colors on account of defect in the retinal cones.[2] Similarly, some persons who are able to see clearly in daylight have difficulty at night, as occurs in so-called "night-blindness" (hemeralopia); this defect is due to an insufficiency in the rods, possibly due to lack of the visual purple. This defect is transmitted from parent to the male offspring through the female parent.

Mental blindness occurs in organic brain disease, in bilateral lesions in the angular gyri, or by a lesion causing interruption in the association pathway between visual and auditory areas. In the latter instance, perception is affected for both sight and hearing as well as for other perceptive processes, resulting in disturbances of speech (aphasia).

If an individual were suddenly deprived of all his senses, or even of vision or hearing, much of his means of gaining knowledge of the external world would be lost, and just so far would he be mentally weakened, unless by substitution of another sense he would be able to receive external sensory stimuli. Strumpell's patient, with universal anæsthesia, bilateral deafness and unilateral blindness, went to sleep, that is, became unconscious, when the sound eye was closed.[3]

Great differences in perceptive activity are found among persons who are regarded as mentally normal. Slowness of perception is marked in certain psychopathic states. Slow reaction is seen in mental fatigue; it accompanies profound depressive emotions, melancholic states, and all forms of mental feebleness.

Illusions.—These are also disorders of the perceptive processes and are related to the sense-organs. Illusions occur as not infrequent phenomena both in health and in disease. An illusion is a qualitative sense deception in which the individual interprets an object or sensation in terms of something different from what it really is. An illusion may be defined as *a false perception of an external reality.* It is always the result of real external sensory stimulus, which results in a real percept which is falsified. Illusions must not be confused with error.

In every-day life of the normal person illusions are common. The experiment of Aristotle, of rolling a pea under the crossed fingers, giving the impression of two peas, is a familiar example. A person sitting in a railway car which is standing, while another train moves slowly in the same direction on another track, receives the sensation that his train is moving. The optical paradoxes of geometric figures are numerous. Thus, two equal lines may be made to appear unequal (Figs. 60 and 61).

In fact, many of our space perceptions are illusory, but are mentally corrected and allowance is made for them.

Bodies of the same weight, but of different volume, placed side by side and raised one after the other, the larger will seem the lighter, especially if the bodies are looked at when the experiment is tried. In this instance we have the influence which our preconceived notions of volume exert upon ideas of weight. We at once think of a greater image of weight as belonging to the larger bodies and therefore we exert a greater muscular effort to raise the larger than when raising

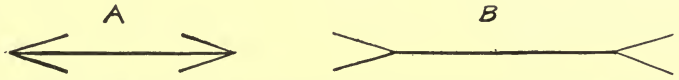


FIG. 60.—Miller—Lyer figure to illustrate illusion in visual perception. The lines A and B are the same length.

the smaller body. Individuals who experience tactile and muscular illusions in amputated limbs do so on account of the peripheral irritation produced by cicatrices of the stump, which irritation arouses old images in the corresponding cortical centres.

Illusions are common in disorders of the mind and, like hallucinations, may involve any of the special senses. They not infrequently occur with hallucinations, especially in the acute confusional toxic psychoses, in which more than one of the special senses are implicated. as in alcoholic psychoses. In such instances the patient misinterprets objects actually seen; for example, figures in the carpet are interpreted

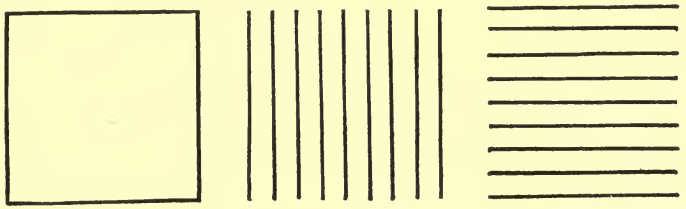


FIG. 61.—Helmholz's squares. All of the squares are of same size.

as animals, faces are seen in the outlines of cracks in the plaster on the walls or ceiling. Many of the so-called hallucinations, especially of touch, taste and smell, are in reality illusions. An illusion of taste is sometimes the result of a real taste perception, such as may accompany a state of disordered digestion, and very common are tactile illusions, which are the outcome of paræsthesias based upon disturbances of organic sensations as well as the special senses.

Sense deceptions are most frequently associated with psychoses that are accompanied by a clouded condition of the intellect, and are especially frequent in the toxic-exhaustive group of psychoses. True hallucinations are rare in melancholia, but pseudo-hallucinations and sensory disorders of tactile origin are common. Examples of the latter

we meet commonly in patients who declare that they have no stomach, or that the body is enormously enlarged; that they have no head; that they are dead. One patient in the writer's experience insisted that only his brain was alive. In the depressive states of middle life such sense deceptions are very common and are doubtless due to disorders of the organic sensations. The sensory disorders of mania appear to be of the nature of paræsthesias rather than of hallucinations or illusions. Concerning the occurrence of hallucinations in paresis, there are many and opposing views held. Paræsthesias are undoubtedly common. On account of the profound disorder of judgment these are usually interpreted so as to lead the observer at first sight to infer that hallucinations are present. Real falsification of the senses in paretics is usually present in those individiduals who are alcoholic, or suffer from some other accompanying toxic state.

Visual sensory deceptions are more apt to occur at night. When they occur during the day they are apt to be more deceptive, as those of the alcoholic, for the reason that they are more like normal experiences. Hallucinations of hearing are the most frequent and are most important on account of the significance of language in mental experience.

Sense deceptions of taste and smell are commonly present at the same time, due to the close physiological relation of the two senses. Such hallucinations are often the basis of the refusal of food by the patient, on the ground that it is offensive and contaminated or actually poisoned. These ideas arise on account of the fact that the sensory effect is almost invariably an unpleasant one.

In practice it is not always possible to distinguish between hallucination and illusion. As we have stated below, hallucination may have a real sensational element in its composition. Doubtless many of the so-called hallucinations are illusions.

Hallucinations.—Among the symptoms presented by patients suffering from mental disorder hallucinations are very apt to be fundamental. The genesis of the symptom can not be explained in many instances, but from the standpoint of its mental origin an hallucination is usually defined as *a false perception without an external object or reality*. For example, voices are heard when all is silent, faces are seen in the window panes when no one is looking through the window; foul odors and tastes are complained of when there is no reality to account for such sensations.

One or more of the special senses are involved in every instance of hallucination. True hallucinations involve only sensory processes and occur independent of the patient's thought. It is common to use the expression that "the senses are hallucinated."

Although by no means an essential factor, yet it must be borne in mind that the perverted function of a sense organ may be the starting point for a sense deception which, if uncorrected by the patient, may give rise to more serious psycho-sensory disorder. For

example, an hyperæsthesia of the retina may give rise to a sensation of flashes of light, stars, mist or color before the eyes. These may be caused directly by opacities of the vitreous humor, an optic neuritis or a choroiditis. The sense of hearing may be disturbed by the presence of roaring or hissing noises, due to atheroma of the otic vessels. An offensive taste is a frequent accompaniment of bad digestion and a thickly coated tongue; the sensation of a bad odor may be associated with disease of the nasal mucosa in which there is involvement of the olfactory filaments. Neuritic conditions commonly give rise to the sensations of numbness, tingling and formication. Such paræsthesias when not associated with mental disorder are at once recognized by the subject as abnormal sensory products and are accordingly corrected mentally.

If the mentally disturbed patient with organic ocular defect or optic nerve disease interprets the flashes of light as a fire which is threatening his safety; or if the patient with otic disease interprets the sounds in his ears as the voices of persecutors; or the patient with unilateral sciatic nerve disease speaks of his paræsthesia in terms of electricity and a vibrating apparatus operated by his enemies, we have instances of disturbance of perception of organic origin.

Disease of the cerebral cortex may give rise to hallucinations, especially of sight and hearing. A patient observed by the writer experienced visual hallucinations confined to the field of a left homonymous hemianopsia in the form of faces on the wall on the left side of her bed. Another patient, a hemiplegic with astereognosis, heard the sound of a man's voice in her head.

Hallucinations are commonly of sufficient intensity to dominate the entire thought of the patient, and to influence his actions as well. Voices may be heard which tell the patient to perform certain acts, that are not uncommonly acts of violence. The voices are often described as being heard in the air, in the walls, under the floor, in the room or on the street.

It is sometimes difficult to distinguish between sensory disturbances which may be the result of real sensory stimuli and those which have a purely mental origin. Often a shadow, or real object, or a sound calls forth a stimulus which gives rise to a second sensation and perception that is false in character and which at first sight one might consider an hallucination, because of the apparent insignificance of the real stimulus. Thus in delirium of intoxication the fluttering of a curtain or the sound of a footstep may terrify the patient. This is brought about as the result of the interpretation of the sensation in terms of something that is not in accordance with reality. Such hallucinations are termed psycho-sensory. Sensory deceptions may be based purely upon the memory of former sensory experiences, especially of sound, "the voice of conscience," the "inner voice," so frequently spoken of by those mentally depressed. Patients sometimes

"feel" on their tongues words spoken by others; in such instances there seems to be a release of a false perception in one sensory field. These are the so-called "reflex hallucinations" of Kalbaum, or sympathetic impressions. In health we see an example of the same when one experiences unpleasant sensations while witnessing a surgical operation for the first time.

All of these "pseudo-hallucinations" must be distinguished from true hallucinations. True hallucinations are characterized by their sensory vividness. Patients not only believe that they hear, see, feel, smell or taste, and so forth, but they really experience the sensations of which they complain. To the patient they are realities, while pseudo-hallucinations are indistinct and rather indefinite in the patient's mind.

It is not uncommon for patients to say that they hear their own thoughts spoken and to believe that they are heard by others. For this reason the patient may believe the examining physician who questions him already knows the thoughts he has in his mind and therefore may not be willing to discuss them.

Again a condition often termed "double thought" occurs in the form of an after-image which follows each idea; for example, when the person is reading and writing. While thinking of one subject the patient may have another, an entirely different idea upon the same subject. This leads to a certain amount of confusion that is manifested by indecision.

As to the mechanism by which hallucinations are brought about there are several views. The definitions of Griesinger, Tuke, Krafft-Ebing and some others are fundamentally based upon Esquirol's notion that hallucinations are original ideas which become intensified and projected externally so that they become sensations. This theory has practically been abandoned. Among the more acceptable theories in the light of present-day knowledge is that of Meynert, who held that hallucinations are a result of an automatic activity of the cortical centres, the primary disorder, therefore, being one of insufficient inhibition and hyperactivity of the lower centres.

Disorders of Attention.—In the consideration of the subject of attention it was stated that in childhood the mental content is chiefly dependent upon accidental experiences. This is a normal condition in the child, also to a certain degree in normal adults, and to a marked degree in idiots. In these instances the individual is forced to respond to external stimuli in the order of their occurrence; in fact those impressions take possession of the centre of the field of consciousness. In adult life training enables one to give attention to certain stimuli and their impressions and to disregard other stimuli. *Distractibility* is the compulsory direction of the attention to accidental external stimuli. Under such conditions attention cannot be divided. At such times attention may be, and often is, given to the details of a complex experience without apprehension of the relation which the component details

bear to one another. In the manic state distractibility is a conspicuous characteristic; also in paresis, dementia præcox, and the toxic-exhaustive psychoses. This is illustrated by the fact that a single movement or sound will serve to distract the patient's attention. The same condition is met in a less marked degree in mental fatigue and in chronic nervous exhaustion.

In states of mental deterioration there is usually serious involvement of attentive power. In true dementia there is often a complete loss; in marked mental fatigue weakening of attention is present to some degree, and to a greater extent in the clouded states of mental confusion.

Attention may be wholly absorbed by a single mental process (hyperprosexia) the most common examples of which are seen in states of depression. In these instances there is an apparent inability to give attention to experiences which do not conform to the depressive ideas and the characteristic emotional tone.

Disorders of Consciousness and Apprehension.—The essential mental factor accompanying the activity of mental processes is the subjective phenomenon which is characterized chiefly by the fact that the individual becomes aware of some mode of affection at the sensorium. During waking hours this state of "consciousness" is continuous, unless interrupted by some abnormal intercurrent condition. When the process by which sensory elements are transformed into conscious processes by interconnection with former experiences is suspended completely we say the individual is unconscious. It has already been stated that in order that a sensation may enter the realm of consciousness a certain intensity of stimulus is essential. The limit of intensity of a stimulus necessary to cross the "threshold of consciousness" is called *threshold value*. Stimuli which do not have this intensity are said to be inadequate. When coma exists the threshold value is greatest; all stimuli are inadequate for the penetration of the field of consciousness. The threshold value is lowest when attention is greatest as during fixed attention. Inasmuch as after a period of unconsciousness the normal state of consciousness is usually recovered slowly, several grades of consciousness are recognized. Consciousness and unconsciousness refer to states which are related to stimuli which are both internal and external.

Some psychologists assume that certain mental processes may exist as "unconscious processes" along with the conscious processes. According to others, such assumptions "are entirely unproductive for psychology" (Wundt).

Consciousness may be interefered with or "clouded," so that either external or internal stimuli are inadequate for the creation of clear impressions, *e.g.*, in epileptic, hysteric and catatonic stupor. In delirious states internal stimuli may produce vivid impressions, while external stimuli have little or no effect; thus, in delirium tremens, the patient is

solely occupied with his hallucinatory impressions of vision and hearing while real external stimuli fail to attract his attention; that is, they do not enter the field of consciousness. In some mental conditions, for example, in the demented states of senility and organic cerebral disease, internal stimuli produce little or no effect, while external stimuli easily gain access to the field of consciousness.

In the strict meaning of the term "clouding of consciousness" implies the defective arrangement of psychical processes and their compounds without any change in the compounds themselves (Wundt).

When the ordinary facts of one's environment are perceived, although not given direct attention, they are said to be apprehended. The process by which percepts are brought to clear comprehension is termed apperception. Percepts must become united with past similar or other experiences in order to be understood. Most of our perceptions are dependent upon such blending of present mental experiences with those of the past. Unfamiliar objects are not clearly perceived, that is, they are not apperceived, because of the absence of the necessary memory of the former experience. The words of an unfamiliar song heard for the first time are usually lost to the listener. On the other hand, a familiar song is clearly perceived, although all of the words may not have been heard, the memories of previous similar experience have supplied the rest. On account of the frequency with which this normally occurs, former ideas may so modify percepts as to cause falsifications of percepts, as in the illusion of the bodies of different volume but of the same weights.

When there is a failure in the coöperation of past mental experiences percepts are not comprehended and consciousness is therefore clouded, out of which arises disordered apprehension. According to the degree of involvement, these states may vary from that which causes ordinary mental fatigue to that of stupor and unconsciousness. Such states may be produced by drugs; also in the toxic-exhaustive, confusional and other delirious states. In a milder degree, disturbances of apprehension are met in manic and melancholic states.

Disorientation.—The ability to comprehend one's relationship to the environment in which he is placed is called one's orientation. To be normally oriented one must know where he is, the time of the day, month or year; who he is, and who the persons are with whom he comes in contact. In some states of disturbance of apprehension such comprehension of environment is wanting; the individual is then said to be disoriented. In delirious states patients are able to apprehend some impressions, and yet may be completely disoriented, as is frequently the case in some of the alcoholic psychoses, particularly in Korsakow's syndrome. In this the disorientation is accompanied by a memory disorder of the amnesic type. The patient may be completely oriented in regard to place and yet totally unable to keep track of time; both recent and remote events are confused in regard to the order of their

occurrence. Disorientation is common in other clouded states of consciousness characterized by a lack of initiative and ability to comprehend external facts and their importance. The lack of orientation may be regarded as fundamentally dependent upon faulty attention, as is commonly seen in dementia præcox.

In states of marked psychomotor retardation facts of environment are perceived, but their relationships are not noted and apprehension is accordingly faulty. Likewise in manic conditions the mental train is so rapid that the patient has not sufficient time in which to correctly apprehend his environment. Defective judgment may also seriously interfere with orientation.

Orientation as to place (spatial) may depend upon a primary perceptive disorder. An hallucinated patient who sees before him a court-room scene and feels himself a prisoner while in the hospital ward is necessarily disoriented as to place. Illusory experiences are very apt to add to the disturbance as in the confusional states associated with clouding of consciousness due to organic cerebral disease, in epilepsy, and in alcoholic psychoses. In the infective-exhaustive and intoxication deliria disorientation is usually marked.

Disorders of the Emotions.—Every sensation is accompanied by a mental state, which is termed "feeling," described in terms of either comfort or discomfort. In a complex of sensations, such as make up the majority of perceptions, there arises a complex of feelings which have a much larger range of variety of content than sensations and their products. Such complexes of feelings may be grouped under two heads, according to whether they are pleasant or unpleasant, and indicate a state of well-being or ill-being of the individual affected. Normally, emotional reactions can, to a certain extent, be controlled. Strong emotions are controlled with great effort; some emotions in abnormal mental states apparently cannot be inhibited. With the affective state there arise concomitant physical phenomena in the form of visceral reactions which enter as part of the general sensation which in its totality constitutes the emotion. The physical reactions are widespread throughout the body and include the muscles, both voluntary and involuntary, blood-vessels, lachrymal and cutaneous glands. According to some authorities, it is not so much the mental experiences which give rise to the emotional state as it is the pronounced visceral reaction. The emotion is an affective state reflexly aroused as the result of a given experience.

Disturbances of the emotions constitute a large part of the symptomatology of mental disorder and may be either quantitative or qualitative.

Diminished and Increased Emotional Reactions.—The quantitative disturbances of the emotions are the most frequent. The intensity of emotional reaction may be diminished. In this condition the patient exhibits a striking indifference towards impressions received. This indifference may exist in spite of the fact that there is little if any dis-

turbance of perception, as in some phases of dementia præcox. In paretics a similar emotional disturbance exists, but with a more marked mental reduction. In all forms of mental deterioration, such as constitute the terminal phase of the chronic mental disorders, the emotional sluggishness is a part of the dementing process. The changes first noted are usually with respect to the individual's attitude towards external things; he takes no interest in his surroundings, and loses his desire for occupation; his natural regard for his family is no longer expressed either in speech or action. In depressed states external impressions produce painful mental reactions, irrespective of the character of the stimulus. The patient is totally absorbed by those impressions, and the emotional tone which is continuously one of depression cannot be altered.

It is this great depression of spirits that leads to suicidal attempts and self-mutilation. When the depression is less marked it may give rise to an attitude of timidity and groundless fears. One patient says that he feels afraid of the people about him, yet he knows no reason for it.

Depressive emotional disorders are often accompanied by evidence of fear; this may become so marked as to give rise to a state of actual frenzy. During these climaxes the patient may exert violent efforts at self-destruction in order to escape impending torture or calamity. If interfered with at such times he may attempt serious acts of violence. The transitory muscular strength possessed by these patients harmonizes with the doctrine of physiologists in regard to emotional states as a preparatory to defensive action.

Disturbance of secretion of the digestive organs and the repellent attitude towards taking food are also in harmony with the doctrine of antagonism between the visceral emotional reactions and those of fear, pain and rage (see p. 96).

Within certain limits emotional irritability and depression are both liable to variation in health. Among the pathological disturbances emotional exaltation is a common phase of emotional disorder. In the milder forms the only variation from the normal may be an increased facility with which the mental processes operate. Such patients think rapidly and with ease; the thoughts seem to "fly through the mind" with great rapidity, while at the same time the patient experiences an exaggerated feeling of well-being. He feels abnormally well (euphoria) and believes himself capable of an unusual amount of work, hence there is an increase of motor activity associated with the exalted emotional state. The patient is more or less constantly occupied in mental or physical effort. One patient in expressing his feeling of pressure of activity said, "I am too busy to spit." Such patients are apt to be good-humored and facetious. Brief periods of anger are not uncommon, especially if attempts are made to interfere with their plans, but even these are soon disregarded and the former mental state is resumed.

In instances in which consciousness is clouded as in the case of the paretic, attacks of emotional exaltation may reach the height of a blind fury; in this the rage is of such character as to give rise to purposeless agitation resulting in serious violence, usually the result of unwise attempts at restraint or interference.

Disorders of Memory Processes.—Disturbances of memory processes fundamentally fall into two groups: (1) those due to defective impressibility and (2) defects due to impaired retentive power. The term **amnesia** is usually employed in a broad sense to indicate lost or diminished power of recollection, and refers to memory loss in general. The processes of memory essentially include the reproduction in consciousness of experiences related to the past. It is impossible to reproduce an idea which has not been once represented in consciousness, that is to say, unless impressions are received and conserved, the recall of those experiences is impossible.

As reproduction cannot take place without the factors impressibility and retentiveness, it follows that the normal operation of memory processes is largely dependent upon the normal completion of the elementary mental processes, and involves the primary sensory and apperceptive processes.

Amnesia may occur as the result of defect of (1) Impressibility—Amnesia of the anterograde type. (2) Retentive Power—Amnesia of defective conservation (retrograde). (3) Power of Recollection—Amnesia of reproduction (retrograde).

1. *Anterograde Amnesia of Defective Impressibility.*—Imperfect perception gives rise to faulty or inadequate impressions of sensory experiences, for which there is either imperfect recollection or an entire absence of memories. Such defects are common to all acute toxic exhaustive psychoses that give rise to confusion. The same is true of all deliria, including the post-epileptic clouded states.

In Korsakow's psychosis impressibility seems to be preserved to a certain extent, as shown by the fact that the patient is able to comprehend for the time certain events of environment, but soon gives evidence that impressions received have faded. Impressibility, in any event, is inadequate to permit of permanent impression and recall.

2. *Retrograde Amnesia of Defective Reaction.*—The point at which the importance of impressibility ends and that of retention begins cannot be established except in theory. Some memories retain impressions much longer than others. This may depend upon the attention given to the experience; when attention is distracted by accidental happenings there is little opportunity for conservation; this occurs in the phase of exaltation of the manic-depressive psychoses. In all dementing processes there is a fading of memories of both recent and remote events, as occurs in the epileptic, paretic, arteriosclerotic and simple senile psychoses. In this group of cases the amnesia ultimately reaches a grade that covers all three forms, and amounts to a total amnesia.

(3) *Retrograde Amnesia of Defective Recollection.*—In this type the power of reproduction is absent or inadequate; some impressions are recalled in part. During convalescence from the toxic exhaustive psychoses it is frequently observed from day to day that the ability to recall experiences increases as the patient approaches the normal.

Other disordered mental processes may either favor or inhibit the essential memory processes. Among these an increase of attentiveness favors the reception and retention of new perceptions, and therefore increases the degree of impressibility. On the other hand, whatever interferes with attention, such as clouding of consciousness, fatigue, indifference and distractibility, will diminish impressibility, as in the defective attentiveness of idiots and some imbeciles. The fact that many dreams are not recalled is explained largely on the ground of diminished impressibility. Memories may be more or less permanently effaced without permanent clouding of consciousness, as in epilepsy, hysteria, paralytic attacks and following traumatism. More serious memory losses follow the deliria of fevers, acute confusional states, and partial recovery from the effects of the exogenous poisons, especially alcohol, and are the result of nutritional disturbances, and the subsequent cerebral atrophy of senility with its attendant enfeeblement of mind. Disorders of memory following traumatism are apt to affect memories of events either just preceding the injury, giving rise to "retrograde amnesia," or of events occurring just after the moment of accident, "anterograde amnesia." Toxic amnesias are characterized by the fact that, after the patient has returned to a state of consciousness, an unbridged gap remains which cannot be filled by memories. There is not only an inability to recall what has occurred during the period of clouded consciousness, but also events preceding the disorder are missing, as well as those covering a certain time after the period of unconsciousness. Still rarer are examples of amnesia without loss of consciousness.

Amnesia includes failure of memory both temporary and permanent, whether characterized by a loss of memory for certain kinds of sensations, as in the amnesic aphasias, or by a loss of the power to recall memories of every variety, covering a definite period of the entire lifetime of the individual.

The following illustrates the manner in which memories referring to a definite period may be effaced:

A young woman while riding horse-back, fell from her horse, striking her head upon the ground. That she was stunned by the concussion was shown by the fact that she lay upon the ground for several minutes without moving. She got up, said to her companion, "I must have lost my stirrup," then walked a short distance and sat down by the roadside. In reply to a passer-by who inquired about her difficulty, she said that she would like some water to bathe her face which had been bruised by the fall. She then walked to a

house near by and became engaged in a discussion of the comparative value of hot and cold water to reduce swelling. She had been talking for some time, giving general information about herself, when, without any break in the conversation, she suddenly asked, "How did I get here?" She then, for the first time, realized that something unusual had happened, and that she had been injured. The last that she could recall was that she was riding along about a hundred yards behind her companion; she had no recollection of having caught up, which she did before she fell. She knew nothing of the accident or of her conversation with the woman at the house, and was greatly surprised to find herself bathing her face at the stranger's house. At the present writing the amnesia for events covering a short period before the accident, the accident itself, and a certain period after the fall still persist. She suffered no other disturbance of memory.

Still more serious memory effacement may occur after partial recovery from the effects of exogeneous poisons, especially alcohol, as is illustrated in the following reported case observed by the writer:

A man, 37 years of age, an excessive drinker for about ten years, after drinking a large quantity of champagne on a wager, abruptly developed mental symptoms other than those of intoxication. On the night of the indulgence, while on the way home, he became excitable, thought that the police were after him, and that he had seduced a young girl. He later passed into a state of stupor from which he could not be roused. Two months afterwards the patient spoke for the first time; said, "What is the matter with me? Where in the devil am I?" after which he lapsed into his former stuporous state. After about three months he emerged from the state of stupor to a condition of ambulatory automatism, first learning to sit up, then to stand, and finally to walk, but did not talk for more than a year. His first attempts at speech indicated a total loss of recollection for all data both prior to and following his state of stupor. He failed to recognize persons or objects with which he was at one time familiar, but had no difficulty in conserving and subsequently reproducing those impressions recalled for him by another person. His memory for facts newly acquired was remarkably tenacious. After a re-education process covering many months he gradually acquired sufficient data to enable him to further educate himself. The condition terminated with a restoration to a normal mental life.[4]

Many of the apparent memory defects seen in mental disorders, such as dementia præcox, profound depressions, paresis, and the senile psychoses, are primarily disorders of attention. Enfeebled attentive power necessarily results in defective impressibility; this in turn interferes with retentiveness. The reverse of this is not necessarily true; for example, in senile psychoses retentiveness is preserved and remote events are recalled accurately and with ease; on the other hand, recent events are soon forgotten because they make little impression.

In states of depression memory processes may be preserved to a remarkable degree. Although perception may be rendered defective by reason of a biased viewpoint, directed by the emotional state, distorted impressions of real experience may be vividly recalled. If judgment is sufficiently defective, the memories of these illusory experiences may be preserved and woven into the fabric of more or less fixed and systematized ideas, giving rise to a paranoid state which complicates the depression.

Disturbances of Train of Thought.—During waking hours there is a constant flow of ideas entering the field of consciousness which makes up the train of thought that passes through the mind. The stream of ideas comprises a number of psychic complexes made up of simpler component parts, each of which is primarily supplied by the senses. The arrangement of this train of complexes normally is more or less definite and, furthermore, is directed towards some "goal idea" and held in proper relation to other ideas by the guiding idea. The flow of ideas is dependent upon associations that are either voluntary or are automatic. Automatic associations are constantly arising in the field of voluntary associations and must be inhibited by fixed attention, just as some sensations are thrust from the centre of the field of consciousness in order that other sensations may be given attention.

The presence of certain kinds of sensory stimuli are of greater psychic value than others. In the average person vision is much more important than all the other senses in the formation of concepts that are to become a premanent part of the store of knowledge. In uneducated persons both vision and audition are essential for the formation of concepts. Most persons are "visuals" in that they are better able to analyze concepts in terms of visual impressions than by any other perceptive process. Thus, one learning a language usually acquires a better and more permanent vocabulary by studying the written (visualized) language than by simply hearing words pronounced. Exceptionally, some individuals find auditory impressions more valuable than visual. A patient recovering from an amnesic state found difficulty in recollecting how to spell words written for him, but could do so easily if they were spelled for him audibly. In other words, he could think better in sound images than in sight images.

In order that the process of ideation may be carried out, a preexisting collection of concepts is a requisite. By reason of the fact that they have originated from former sensory experiences, these concepts become more or less permanent and are therefore more easily recalled. Sometimes a part of a concept is recalled in place of the complete idea; a common example of this occurs in the use of abbreviations.

Among the disorders of the train of thought there may be either a diminution or absence of concept formation or a perverted activity of the process. The process of concept formation may be retarded through defective mental development, as in imbeciles in whom the

ability to construct new ideas for the development of thought is either prevented entirely or retarded. In dementia the same defect comes on later; new impressions are either not utilized, or if they are, they are not retained; on this account the store of ideas becomes gradually smaller and smaller.

Paralysis of thought begins as a retardation that finally reaches a degree of enfeeblement in which thought may be reduced to a single idea. A patient, deteriorating mentally, shot himself early in the course of the disorder from which he suffered. As the result of the head wound there remained a paresis of the left arm. The only idea expressed by the patient was that the affected arm should be amputated. Even after he lost the power of voluntary speech he clearly indicated by gesture that the idea still persisted.

The direct opposite of paralysis of thought and retardation is morbid imagination. In this condition ideas bearing no relation to one another may become associated in the form of false ideas, as in the extravagant ideas expressed by paretics and precocious dements.

Imperative Ideas—Fixed Ideas—Compulsive Ideas—Obsessions—Phobias.—The normal train of thought may be interrupted by the seizing and monopolizing of the field of consciousness by ideas which break in upon and seriously interfere with logical thought. Legrain states: "Every cerebral manifestation, either of the intellect or of the affections, which in spite of the efforts of the will, forces itself upon the mind, thus interrupting for a time, or in an intermittent manner, the regular course of the association of ideas, is an obsession. Every action, consciously accomplished, which cannot be inhibited by an effort of will is an impulse."

These ideas originate upon the basis of a morbid emotional state and hence constitute a foundation for a mental conflict between the persistent and morbid ideas and the normal logical thought processes. The patient feels compelled to think of some unpleasant experience which he ordinarily would endeavor to forget; he may be compelled to think revolting thoughts. Often the individual feels that he is being influenced by some external force or power, which he may say he knows could not really exist, yet he is unable to recognize the fact that the controlling power is his own abnormal emotional state. A parallel mental state we meet in health when one feels a compulsion to recall a certain name, to hum a certain tune, or answer impossible questions, such as relate to the "mystery of life." In extreme examples of this kind of disorder of thought the entire thought train is dominated by such ideas. Often when one idea has been removed, it is immediately followed by another, the presence of which makes the individual equally miserable. Normally, when one has no definite object in thought—no "fixed goal" in the train of thought—certain ideas may persist in consciousness but without any unpleasant feeling of compulsion. Examples of the existence of persistent ideas are not uncommon in mental health,

as when rhymes and tunes persist in our minds in spite of every effort to be rid of them. Commonly the imperative idea takes the form of a fear (phobia) or of a doubt. The phobias are numerous, but are usually confined in each instance to a very definite object or a definite class of objects. The fear of dirt or contamination may so obsess the patient that his life is made miserable excepting in sleep. In these instances the greater part of the patient's day may be occupied in washing the hands. No sooner is one ablution ended than another is begun for fear that the last was not effectual. A patient spent the larger part of every day dressing and undressing, fearing after robing was complete that a bowel movement might have occurred without being conscious of it, and the clothing thereby soiled. When questioned, the patient would say, "I know there is nothing to be found, but it is impossible to resist looking." Whenever the act which the obsession stimulates, as in the act of washing, is interfered with, and especially if by another person, the desire to carry out the act is made all the stronger, and usually gives rise to added mental discomfort that may amount to transitory loss of self-control.

The fundamental element in the obsession and the impulsive act is a disorder of the mental processes which take part in the production of an act of will. There is either an inability to choose between two lines of action, an inability to inhibit a thought or action, or an inability to initiate a thought or action. It therefore depends upon an **aboulia.**

The aboulias are found in hysteria, psychasthenia and in other psychoses, especially the depressions.

The other common group of imperative ideas take the form of obsessions of doubt. Normally, it is not uncommon for one to make a second investigation after retiring to make sure that a door has been locked, or a gas jet turned off. When the person cannot satisfy his doubt concerning such matter, but is compelled to make trip after trip with the same object in view, the idea becomes an obsession. Such a patient was obliged to get out of bed many times during the night to see whether a certain stone he had noticed lying on the street in front of his house was faced with its small end or the large end upward. Similar doubts made the patient's days and nights miserable until he became so worn out that he was forced to give up work and to seek institutional care.

Although not strictly belonging in the same class as that of the patient who suffers from imperative ideas, we see similar mental states in some of the depressive psychoses. In the instances occurring in and after middle life, when the patients have passed through a long period of depression with delusions of self-accusation, they are apt to show a state of fear or doubt after the definite delusions have disappeared. A patient was dominated for months by the belief that on account of dishonesty his soul was lost and perdition was his doom. With the disappearance of this idea there developed the fear that he ought not to touch anything lest he should become contaminated with dirt.

Flight of Ideas.—When the object of thought rapidly changes, the one idea being forced aside, as it were, by another entering the conscious foreground, ideas may follow one another in rapid succession without any regard for the coherence of association. The ideas are commonly brought about partly as the result of the mobility of attention and partly by external impressions and chance associations. Ideas often seem to enter the mind faster than they can be expressed, hence one sentence may not be finished before another is begun. This is primarily a disorder in which the automatic association takes precedence over the voluntary association. It is a common symptom in manic states, as in manic-depressive psychoses; also in the acute confusional psychoses as in the intoxications and in dementia præcox.

There is a delirious form of flight of ideas which occurs in the graver toxic conditions. In this the flight of ideas takes the form of a succession of imaginative ideas having no relation to one another, and either not founded upon experience or upon false sensory impressions. When the usual train of thought is diverted by other and less important ideas, but with a tendency to return to the original idea, as in mild manic conditions, the train of thought is said to be **rambling.**

In **hypomania** the patient often feels that he can think more easily than usual; thoughts flow into his mind without effort, so that with the disorder of the train of thought there is commonly an exaggerated feeling of well-being. This may lead the patient to think that he was never in better mental health in his life.

Disorder of Content of Thought and Judgment: Delusion.—We have thus far seen that all mental experiences depend primarily upon the affection of the senses by external stimuli resulting in sensations and perceptions in common parlance known as images or impressions. Furthermore, we have learned that the same impressions or rather their equivalents may be reproduced as memories. The aggregation of images is an essential psychological feature in the production of ideas which may be either simple or complex; they are psychic compounds "composed entirely or chiefly of sensations," according to Wundt. Some psychologists regard an idea as differing from perception only in the fact that the former consists wholly of images, and may be simple or composite. When an object is placed before an observer who looks at it, the object is perceived; when, however, the observer closes his eyes he "ideates" the object.* As we have already noted, ideas which originate in experience or imagination tend to form themselves into groups by reason of the associative tendency, so that any two stimuli entering the field of consciousness establish a tendency for the recurrence of the one stimulus to arouse an idea of the other. This associative process may go on without any effort of the part of the individual, or it may be consciously directed by the aid of attention when the result is termed a "judgment."

* Tichener, p. 376.

Morbidly falsified beliefs that cannot be corrected by evidence are termed **delusions.** A delusion is a false belief, but all false beliefs are not delusions. We have already stated that in determining the presence or absence of mental disorder we must compare the man we see with the man as he was before he came into his altered state of mind. In the same manner in determining whether a belief is the outcome of delusive ideas it is essential to know what was or what would have been the individual's notion concerning the same or allied subjects when in his accepted normal state. Beliefs are greatly dependent upon education and environment, especially among the uncultured. Each instance of supposed delusion must therefore be judged upon its merits. The belief in ghosts and evil-possession was at one time widespread among people of all classes; the history of witchcraft in Salem illustrates the effect of education and environment in the promulgation of such belief. In some localities at the present time can be found among certain classes, persons who firmly believe in fairies. Among educated and cultured persons certain beliefs become fixed by reason of precept and cannot be displaced by argument, as is true of political and religious convictions. These characteristics of normal thought must be taken into consideration in the study of the delusive ideas of disordered minds. Another element which should be eliminated is that of error from which delusion must be distinguished; this can only be done after considering the causes and consequences, which give to delusions a pathological character not possessed by the former. Furthermore, it is not only the delusive nature of the idea which characterizes it as a delusion, but it is the background upon which it is constructed that characterizes it as a pathological idea. The inaccessibility to reason is a characteristic ever present in delusion. No amount of argument or evidence, or even experience, can correct the delusion so long as the idea exists. This is doubtless due to the fact that delusions are not the result of real experience; if due to experience at all, they frequently are based upon hallucinations of the senses. Just as in the normal, definite experiences give rise to reactions on the part of the individual, so we find disorders of perception giving rise to false conclusions. Thus, a patient who hears false voices soon interprets them as threats and concludes that he is persecuted. Distress in the epigastrium may eventually induce the belief that there is an animal in the stomach, or may give rise to the belief that it is wrong or impossible to take food. Delusions referring to the taking of food in patients depressed may be regarded as adjustments or adaptive reactions brought about by the accompanying painful emotional state and fear, which give rise to inhibitive reactions on the part of the digestive apparatus (see Interrelation of Emotional Reactions, p. 96).

When carefully analyzed, however, all delusions will be found to be of subjective origin, and therefore to refer to the self; they are concerned with some phase of the individual's welfare, and appear to

be the outcome of an attempt at adjustment of the individual to his apparently altered environment; in fact, an attempt on the part of the patient to explain his disturbed feelings. The content of the delusional idea is largely in accord with the emotional state; in fact, the disorders of emotion appear to be the important factor in the genesis of delusions. Melancholics frequently appear depressed emotionally before the appearance of their delusions; the paretic is exalted before the appearance of the delusion which characterizes his emotional state.

Just as in health mental experiences are accompanied by states which are characterized affectively by comfort or discomfort, so in abnormal states the accompanying delusions correspond to the emotional tone present. This has given rise to the classification of delusions into two large groups: (1) *expansive* and *grandiose,* and (2) *painful* and *depressive.* Delusions appear as a qualitative disturbance of the process of the formation of ideas; the formative process of thought is altered, thus giving rise to conclusions which do not correspond with reality. The content of delusions is usually in contrast with reality and even at times with possibility, and in the grandiose type often reach a degree of extravagance. Thus a paretic patient believes that his members are made of ivory; that he is the tallest man in the world; that he is a multimillionaire; that he is the possessor of gold houses and diamond automobiles. Commonly, delusions are based upon a sense of adequacy (euphoria) and refer to the state of the body. One of the evidences of the fact that such delusions refer to self is the influence which the delusions exercise over the actions of the patient. A paretic. who is a trifle over five feet tall, says that he measures eighteen feet tall; to demonstrate the truth of his belief he stands on his toes in order that he can reach with his extended finger tips an imaginary mark on the wall to represent his height; he furthermore says he is the richest man in the world; that he has the most beautiful wife in the world and eighty children. The same patient thought that he could change the features of anyone who wished to become beautiful. This latter idea was carried to such an extreme that one day while he was going through the movements by which he believed he was "making heads," the patient looking up towards the ceiling was heard to say, "Hello, God, throw down another skull."

Many delusions are based upon a feeling of inadequacy and characterize the painful and depressive psychoses. Thus a person whose chief happiness during health was derived from the thoughts of the rewards of the future life, may be distressed with the belief that she is irretrievably lost. A patient suffering from a second attack of the depressive type of manic-depressive psychosis believes that on account of his failure when a young man to respond to the call of God he was made "the vilest creature in the world, and more than lost." This idea was so dominant in his mind that at times he would get down on his hands and knees and crawl about the room, so degraded did he feel. The

idea that some unexpressed or unknown wrong has been committed is one of the most common subjects met among the delusions of the depressed states. Expansive delusions may give rise to the patient's belief that he occupies an exalted position in the social world and consequently he may believe that he is descended from royal ancestors, or may himself be a king, emperor, or even Christ or God. Concerning his prospective accession to a regal throne, a paretic patient reasoned as follows: "There is only one other man in the world whose name is the same as mine, that is the Lord Mayor K. (the patient's family name) therefore I shall some day be on the throne of Scotland."

In the deteriorating psychoses the delusions are more disposed to take on a ridiculous character. A paretic may be so feeble that he can scarcely stand and yet stoutly affirm that he is the strongest man alive. Similar ideas with reference to mental ability and accomplishments and education give an idea of the patient's opinion of his mental state. In conditions of mental weakness this lack of insight is a characteristic attitude. Illustrative of the impossible character of the content of some delusions, a patient believed that he was the possessor of numerous patents of inestimable value, one of which involved a plan by which he would dry up the Atlantic Ocean to make room for planting cranberry beds, from which he could supply the world's markets, and thus gain untold wealth.

Practically all delusions refer to the individual's self and represent a belief in the existence of either personal adequacy or inadequacy. The latter beliefs occur in the majority of cases, taking all forms of mental disease into account. A very common delusive idea, a feeling of inadequacy, is that of self-accusation with a fear of poverty and impending calamity. A person thus depressed may consider himself the most sinful person in the world and to have committed a crime for which there is no pardon; former friends are no longer interested and members of the family no longer possess their former love for the patient; even other patients in the hospital seem to him to show a dislike towards him; he is not wanted at the table, hence he does not eat; every night is to be his last as he is to be killed by horrible tortures; those about him are constantly whispering and seem to him to delight in his misery. Food has to him an unnatural taste and leads to the belief that attempts are made to poison him. Another patient believes herself horribly deformed and disfigured by a cancerous disease of her face and therefore shuns society.

Delusions are frequently so persistent and unvarying, apparently the result of a logical reasoning based upon false premises, that they become a permanent part of the individual's mental life. Such delusions are said to be **systematized.** Other delusive ideas may grow out of the original delusion; thus, the victim of persecutory ideas sees the reason for his persecution in his unusual ability or his right to reach positions of high station or in his great wealth. It is in this way that

patients are given credit for having many and varied delusions, whereas in reality there is but one delusion which remains unchanged, while the variation lies only in the method of expressing it.*

In the acute mental disorders, as in states of exaltation and depression, delusions when present are more apt to be unsystematized and variable in character. In such instances the prognosis is usually good as to recovery. In chronic mental disorders with delusions fixed and constant the prognosis is more unfavorable. Certain mental states which form a part of a general disturbance of the psychic life of the individual may have a strong influence upon the falsification of ideas.

Intense emotional states, especially sorrow and fear, commonly give color to the delusions; with an alteration of the emotional state the delusion may change in character or disappear entirely. Thus, a patient greatly depressed and dominated by the fear of impending punishment on account of imaginary crimes, may show a change from the depressive emotional tone to that of mild exaltation and become haughty and sarcastic, and maintain that he is made the subject of taunts and sneers, and that something is done to him while he sleeps in order to belittle him, that food is prepared in such a way as to disgust him and that he is being spied upon from every side.

Clouding of consciousness aids in the development of delusions, especially in deliria and confusional states, as in febrile and alcoholic psychoses. In these instances there is little disturbance of the emotions. A similar state occurs in dreams; as soon as entire consciouness is regained the false impressions are corrected.

Psychic weakness appears to favor the development of delusions in certain disorders, especially paresis, dementia præcox and senile dementia, on account of the associated disturbance of consciousness and defective judgment. In the congenitally weak-minded in whom the reasoning power has always been below par the tendency to the development of delusions is slight.

Delusions that are the result of both mental weakness and associated emotional disturbances are apt to be forgotten before they are corrected in the mind of the patient. This is a common characteristic of the delusions of the paretic and the senile dement. Delusions may be apparently logically reasoned from false premises, the patient at the same time seeming intellectually vigorous in the discussion of other topics. This is one of the marks of the delusions of the paranoiac, arising out of his abnormal attitude towards experiences but with little or no apparent mental deterioration.

Some patients are able to mask their abnormal thoughts and act in an apparently normal manner in spite of the fixity of delusions. This is commonly affected by paranoiacs in order to escape hospital detention.

* Ideas which refer to the personality of the patient have been designated "autopsychic"; ideas referring to the patient's body as "somatopsychic"; ideas referring to some other person are termed "allopsychic."

In illustration of this fact, a patient believed that he had been poisoned by his enemies, and as a result of this belief refused to take food and required mechanical feeding to sustain him. After a few months he grew tired of the separation from his family and friends and the mechanical feeding and he unexpectedly began taking food, became bright and cheerful, and said that he felt that he was getting well; later the patient was sent home apparently much improved. This patient stated to the writer that his improvement was only feigned; that it was a scheme he had worked in order that he might be sent home; that he knew he did wrong in eating; that he did not shoot his persecutors because of the disgrace he would bring upon his family.

Disturbances of Volition and Conduct—Abnormal Behavior.—Actions in their totality, as carried out by an individual, are denominated by the term conduct. Motor acts are dependent upon (1) sensory impressions and their dependent mental states, (2) the accompanying emotional state or "attitude" towards these experiences, to which must be added (3) instinctive reactions, either inherited or acquired through education, (4) volitional responses, and (5) voluntary action.

(1) Sensory impressions are often directly responsible for the behavior of the mentally disordered person in the same way that sensations affect behavior in health. Hallucinations of the senses are potent factors in controlling the train of thought and also the development of delusive ideas, and consequently give rise to variations from the individual's normal conduct. The patient who hears threatening voices assumes an attitude of defence towards his supposed enemies, or an attitude of fear, and consequently shrinks from contact with his fellows. Another patient who feels that she is subjected to electric currents by her supposed persecutors always carried an umbrella for protection when going out of doors. The patient who has olfactory and gustatory hallucinations refuses food for fear of being poisoned. In patients with profound defect of judgment the reactions are often extreme and even ridiculous. This is especially true in those sensory disturbances which are more correctly regarded as disorders of the organic sensations, as occur commonly in paretics. For example, a man felt electric currents in his hands, and for fear of giving himself an electric shock went about with his arms extended almost in a straight line. In disturbances of attention, which may be also regarded as the attitude of the subject towards his experiences, there may be a diminution of bodily activity due to lack of responses to stimuli, as the result of enfeebled attentive powers or to indifference.

(2) The behavior of the individual depends upon the emotional state, whether depressed or exalted. In depressed emotional states there is usually retardation of the rate of thought and in many instances an impoverishment of the thought content not infrequently

reduced to a single persistent idea; for example, the idea of sinfulness. poverty or personal inadequacy. With this sluggishness of the train of ideas there is usually slowness of bodily activity. As in the normal, the man who thinks slowly usually is slow in his actions as he is in his reactions. In profoundly depressed patients there may be little or no voluntary activity. These patients will sit idle all day if permitted, paying no attention to external stimuli, and require to be directed in all their efforts. The symptom as a whole is commonly termed **psychomotor retardation.**

In states of emotional exaltation we find the conditions reversed. With the euphoria there is a rapid flow of ideas with increased activity and rapidity of action. These patients are rarely still; they are loquacious and usually happy, inclined to be witty, facetious or irritable, petulant and snappy.

In states of euphoria the patient's conduct often is such as to furnish the first outward evidence of the existence of serious mental disorder. This is especially true in the incipient stage of paresis and in hypomanic states. In such patients the abnormal feeling of well-being gives rise to the development of grandiose delusive ideas and conduct to correspond with those ideas.

(3) Those acts which fundamentally conform to the so-called reflex type of action, which occur as a response to external stimuli, and which in lower animals cannot be avoided, are the purely instinctive types of behavior. Among the demented class of patients it is frequently noted that the acts are distinctly "animal" in their characteristics. The normally acquired inhibition is often lacking, leaving the purely instinctive reactions dominant. We find in such patients abnormal sexual irritability and frequent masturbation, eating of filth, and other repulsive habits.

As already noted in advanced dementia, we find that activity is limited to such instinctive acts as prehension and repulsion, especially in the taking of food.

(4) Volitional responses are psychologically so closely connected with emotions that disorders of conduct depending upon volitional disturbances might just as correctly be discussed under emotional factors as under volition. In some mental disorders, and especially in the catatonic state, there is an absence or diminution of activity due to "blocking" of emotional processes, which thus interferes with activity. Motor acts begun are not completed; an act which has been initiated properly, suddenly is brought to a close as if by some interruption. And just as suddenly, as if by the release of an impediment or the cessation of some opposing influence, the act may be brought to its completion. Such patients do not respond with the natural defensive reaction when one assumes a threatening attitude towards the patient. They often remain for hours in what would normally be uncomfortable positions or situations without any evidence of discomfort or inconvenience.

(5) Assuming that true voluntary acts imply the existence of a complex of emotional states or a succession of emotions out of which one must be selected for reaction, there is at once to be considered an element of choice.

The disorders of conduct which depend upon disturbances of voluntary action are in reality the result of disorder of judgment and are discussed under **delusion** (*q. v.*).

The real disorder of conduct, or the abnormal behavior of the patient, depends therefore upon a disturbance of the various mental components which are normally responsible for the reactions of the individual. The true disorders of behavior depend chiefly upon the last two groups named; that is, disturbances of the instinctive reactions and disorders of volition.

Upon the basis of Meynert's work Wernicke[5] founded his interpretation of the symptoms of mental disorders, regarding it as only a matter of difference in the kind of general brain disease, which distinguishes mental disease from the general or focal organic brain disease.

As the projection fields are the areas in which are represented the functions of the nervous system, the majority of focal symptoms may be traced to local interruptions in the projection system, and it is the fading of the images located in those fields that furnishes the symptoms of focal brain disease.

In mental disease the projection systems are not affected as in focal disease, according to Wernicke.

Wernicke considers transcortical aphasia, that is, destruction of the association paths as a transition phase towards mental disease, and he claims for these paths the seat of mental disease, provided the assumption is correct that the anatomical value of the association paths is for the connection of the projection fields.

He cites the instances in which two psychic symptoms, resembling complete motor and partial sensory aphasia, namely, verbigeration and mutism, occur as a development of a definite mental disorder (evidently referring to dementia præcox), while the sensory speech field and tract are intact, evidenced by the fact that patients understand all that is said to them.

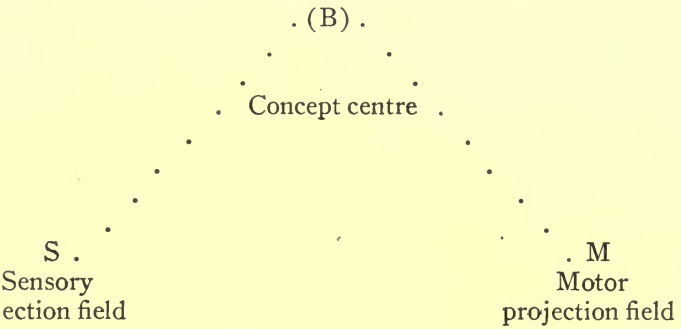
Wernicke explains the irrational speech on the basis of the supposition that the association paths are affected, and he regards every case of mental disorder in which there are manifest senseless assertions with no reference to questions asked as examples of transcortical aphasia.

The association paths are continued through the projection fields to a supposed concept centre, which in reality is distributed in separated portions of the cortex.

Using language in illustration, two processes are concerned in language comprehension:

1. The recognition of the *word-clang* images—the function of the sensory projection field; this Wernicke terms "primary identification."

2. The rise of the concept joined to the word—the function of the sensory association paths with the concept centre; this is termed by Wernicke "secondary identification."



The concept rises after it is received at S, but must be conducted by anatomical paths to the motor projection field at M in order that the word may be spoken.

The message is received at S, but the real recipient is at B. Again the real sender is B, but M is the station from which the message is sent.

The presumed concept centre is, in a certain sense, incapable of localization. In addition to the functions ascribed to the central projection fields, Wernicke concedes to them the attribute of being the places for memory images. Inability to recognize objects by touch is associated with disease of the middle of the post-central gyrus, with little if any disturbance of ordinary sensation. Spinal and peripheral nerve disorders may be accompanied by marked sensory disturbance without loss of ability to recognize objects by touch. In the cerebral lesion there is loss of primary identification; in the lower neuron involvement impulses carried to the cortex are sufficient for identification even though the projection paths are defective.

Through the readiness with which frequently repeated stimuli act, is dexterity developed; paths once traversed by stimuli with difficulty are made more easily passable; a spinal reflex occurs more readily the more often it has occurred. The after-image of the retina has been properly referred to the ganglion cells of the retina. Ganglion cells possess the attribute of being permanently changed by transitory stimulation. In the brain cortex Wernicke likens similar residua in the cells to the after-images, and calls them mnemonic (memory) images. He further states that the possession of mnemonic images, or content of consciousness, is directly dependent upon the condition of the projection system and the peripheral organ by which that possession has been gained.

A person with defective sensory apparatus differs mentally from one with normal sense processes and organs. A person born deaf is defective in memory images of an auditory character; one born blind is

mind-blind, that is, he has no visual memory images. Through defective projection fields the imbecile suffers an absence of such images.

In this way, Wernicke considers that the content of consciousness shows its dependence on the condition of the projection fields, and therefore that consciousness is a function of those fields, and also that consciousness is a function of the cortex of the brain mantle.

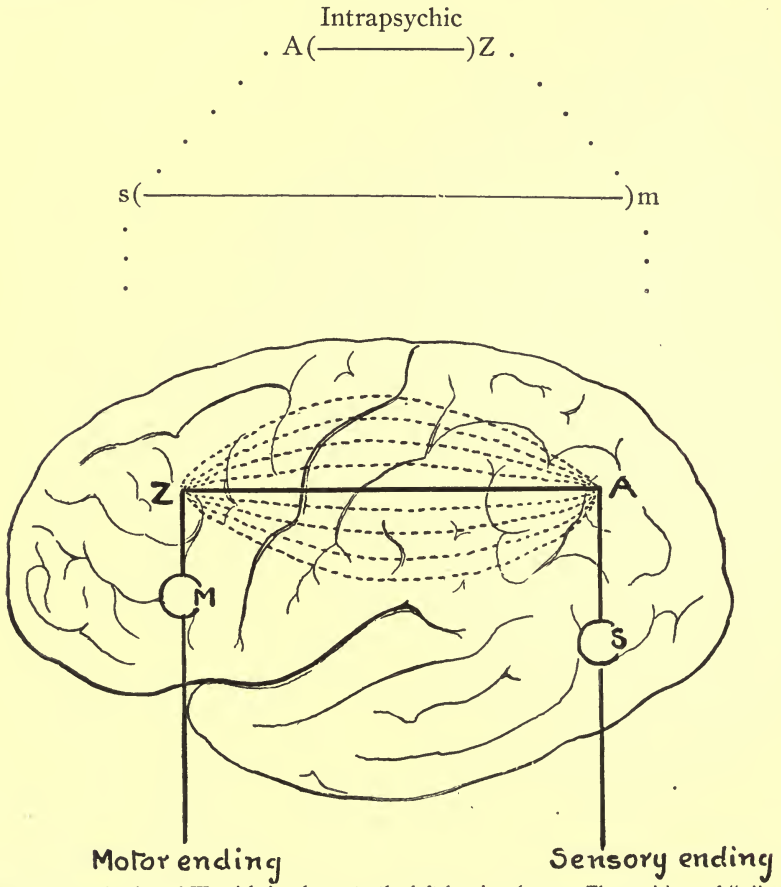


FIG. 62.—Application of Wernicke's scheme to the left hemicerebrum. The positions of "s" and "m" are necessarily reversed to agree with the motor and sensory areas.

Wernicke assumes the concept centre **B** to be divided into localizable ideas **A** and **Z** connected by an association path **AZ**, and that **A** represents the initial idea, united with the sensory speech field by the association path **sA**; that **Z** represents the terminal idea also connected by a similar association path with the motor projection field **Zm** (Fig. 62).

A problem is comprehended at **A**; its solution has taken place at **Z**; and when transformed into spoken language is innervated at

m. Between **A** the problem, and **Z** the solution, there may occur other complicated trains of thought.

Psychosensory refers to sensations received into the field of consciousness; psychomotor refers to motor acts occurring during consciousness. All that occurs in consciousness is included in **sAZm.**

The schematic arrangement of Wernicke can be made to apply to any of the projection fields, replacing speech with any other motor manifestation. The path **sAZm** may be regarded as a reflex and termed the "**psychic reflex arc.**"

Disturbances in the path of the reflex arc will give rise to symptoms, according to whether the psychosensory **(sA)**, the psychomotor **(Zm)**, or the intrapsychic **(AZ)** is involved.

The possibilities according to this scheme are:

Psychosensory	**Psychomotor**	**Intrapsychic**
Anæsthesia	Akinesis	Afunction
Hypærasthesia	Hyperkinesis	Hyperfunction
Paræsthesia	Parakinesis	Parafunction

GENERAL SYMPTOMATOLOGY

I. Disturbances of Sensation and the Process of Perception

1. Hallucination—False Perception (sense falsification) without an object or external stimulus.

2. Illusion—False perception with an objective reality (sense deception); falsification of a real experience.

3. Disturbances of Consciousness—Coma, stupor, clouding, "befogged states." Stimuli inadequate to arouse mental activity, or to permit of clear psychic content—raised threshold.

4. Disturbances of Apprehension—Failure to note and comprehend environment—diminished sensibility, *e.g.,* stupor, fatigue, narcotism.

5. Disturbances of Attention—Diminution or absence; distractibility. Hyperprosexia—total absorption of attention.

II. Disturbances of Association Processes

1. Disturbances of Memory—Amnesia, paramnesia, falsification of memory.

2. Disturbance of Orientation—Inadequate comprehension of environment in relation to time, place and person.

3. Disturbance of Formation of Ideas—Incompleteness or lack of retention of effects of sensory stimuli; failure of association.

4. Disturbance of Train of Thought—Paralysis of thought, impulsive ideas, persistent ideas (obsessions), flight of ideas.

5. Disturbance of Judgment and Reasoning—Delusion: A false, conclusion (belief) due to disease. Usually refer to self: depressive,

hypochondriacal, self-accusatory, personal inadequacy, nihilistic; grandiose, persecutory—systematized, unsystematized.

6. Disturbance of Rate of Flow of Ideas—Retarded in depressions and stupor; accelerated in excitement.

7. Disturbance of Capacity for Mental Work—Increased susceptibility to fatigue; distractibility.

8. Disturbances of Self-Consciousness—Dual consciousness, "double consciousness," altered personality.

III. Disturbances of the Emotions—Abnormal Attitudes towards Experiences

1. Emotional Irritability—Increased; indifference; diminished, paradoxical emotional attitudes.

2. Morbid Temperaments—Apprehensiveness; irritability; frivolity; seclusiveness.

3. Morbid Emotions—Morbid fears, compulsive fears; "drunkard's humor"; ecstasy, euphoria.

4. Disturbance of General Feelings—Fatigue, hunger, nausea, pain, sexual feelings, feeling of shame; perverted feelings.

IV. Disturbances of Volition and Action

1. Diminished Volitional Impulses—Complete—paralysis ot will. Retardation in depressions—indicated by inactivity or slowness of action.

2. Increased Volitional Impulse—Indicated by motor excitement, as in manic states—psychomotor excess.

3. Altered Susceptibility of the Will—Weakening; hypersuggestibility, mutism, negativism, echolalia, echopraxia.

4. Stereotypy—Continued hypertension of definite muscle groups; repetition of movements—stereotyped movements, (mannerisms).

5. Compulsive Acts—Acts seeming to be forced by an extrapsychic influence.

6. Impulsive Acts—Acts resulting from an uncontrollable intrapsychic influence arising within the patient.

7. Morbid Impulses—Kleptomania, pyromania, dipsomania, contrary sexual instinct.

8. Morbid Expression—Speech and writing—dysarthia.

9. Morbid Conduct—Dependent upon delusion of volitional disturbance—abnormal behavior.

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CHAPTER X

METHODS OF EXAMINATION

The examination of the patient from the psychiatric standpoint involves the search for symptoms and physical signs of disorder or disease which affect the reactions of the individual as a whole, thus preventing him from making those adjustments of which he normally was capable. It is not sufficient to direct the examination to the determination of whether or not the patient is suffering from mental disturbance; equally important is the differentiation of the reaction-type which may vary in different patients presenting psychoses which at first sight appear similar. In some cases the mental disorder is patent enough; in others the question is more difficult in its solution, and for the time may involve a social problem for the opinion of the physician as an alienist.

Psychiatry is interested from the medical and biological standpoints; from the point of view which regards the patient as an individual unlike every other patient, who is suffering from a disorder, or rather from several disorders, which give rise to reactions affecting his somatic functions, and, in addition, to reactions affecting the individual as a whole, and precluding the possibility of his making adjustment to environment because of some interference with the normal operation of the mental processes in addition to a physical disorder.

The possibility of the existence of a physical disease, such as typhoid fever, which may be accountable for the mental symptoms, must be taken into account. To obviate the error of sending to a special hospital for mental diseases such a patient, it becomes imperative that each delirious, confused or stuporous patient be studied with the same available clinical and laboratory methods of diagnostic precision as one would employ for the determination of the cause and nature of a purely physical disorder.

Furthermore, from the mental standpoint, one patient may be found greatly depressed and retarded, so that he is inattentive, mute and inactive as the result of a primary physical disorder, such as anæmia, autointoxication, alcoholism, neurosyphilis or other post-infectious processes; another patient may present the same symptom-complex due partly to extrinsic factors, but largely as the outcome of biogenetic factors which lead to physical and mental insufficiency such as is seen in the schizophrenic psychoses so commonly met in adolescents.

Anamnesis.—The history of the development of a psychosis in every case occupies a position of prime importance and may involve the study of the patient's life-history. It is often upon the basis of the history alone that a tentative diagnosis can be made. Furthermore, it is

important that data shall be obtained from as many reliable sources as possible and the notes compared from the standpoint of accuracy. Well-meaning informants may omit important information while others may exaggerate unwittingly some facts which may be relatively of less importance than others. The first interview may serve for obtaining the essential data, the details of which may be sought later.

Family History.—This part of the history is often elicited with difficulty and yet when accurate is of great assistance in the determination of the causal factors in the production of psychosis. In most instances careful questioning will furnish a sufficient clue to enable the examiner to obtain a general idea of the patient's familial characteristics. It is rarely wise to begin with questioning the relatives concerning the occurrence of mental disorder. For reasons peculiar to the informant this information may be withheld.

If a history of the occurrence of actual psychoses cannot be elicited, inquire concerning other indications of neuropathic heredity—alcoholism, mental peculiarities, eccentricities of character, suicide, migraine, or any indication of functional nervous disorder. Whether or not there is any definite neuropathic history, the presence or absence of apoplexy, convulsions, Bright's disease, or tuberculosis should be determined. It is important to note whether the parents of the patient were of blood relation before marriage; whether luetic, alcoholic, or addicted to the use of any drug. When lues is denied, or if for any reason, direct questions in regard to syphilis should not be asked, it is better to interrogate indirectly, inquiring concerning skin diseases or eruptions, falling of the hair, rheumatic pains, iritis, bone disease and miscarriages. Though positive answers concerning any of these will not be necessarily regarded as conclusive evidence, they have their value in summing up the case.

Personal History.—(Infancy and Childhood).—This part of the history should include a statement of the health of the mother during gestation and the puerperal state, especially with regard to nephritis, acute infectious disease, severe emotional shock and birth traumata. Inquire whether the birth took place at term or prematurely, whether it was a natural or instrumental delivery, and any apparent effect upon the child, and whether breast-fed and for what length of time.

Determine what infectious diseases occurred during the period of infancy and, if any, what complications. The occurrence of convulsions, especially during the dentition period; paralysis, and whether present at the time of delivery or of later occurrence; the occurrence of head or other injury, and the apparent effects, should be noted. Ascertain the period at which the patient learned to walk and to talk, and in childhood the progress in school and the character of the physical and mental development, whether precocious, delayed or in any way abnormal. Interrogate concerning mental crises during puberty; especially important to note are eccentricities of character developed at

this period. In girls should be noted the age at which the menses appeared, and whether or not they were accompanied by any unusual physical disturbance, such as pain, anæmia, or nervous manifestations, or conspicuous mental changes, such as unusual depression or abnormal convictions concerning any single topic.

Concerning the later period of the development of the patient should be noted the state of the general health; the occurrence of infectious disease, such as typhoid fever, pneumonia, malaria, meningitis, digestive disorders; also of constitutional disease—tuberculosis, syphilis; the practice of masturbation, sexual impulses, morbid temperament, hysterical manifestations, epileptic seizures, hypochondriasis.

In adult life it is important to determine what sort of a person the patient was before the appearance of the symptoms, whether any personal idiosyncrasies, exaggerated egotism, one-sided intellectual development in other directions. All information should be obtained from as direct a source as is possible. The individual's views of life in general, whether he was pessimistic or optimistic, and his general ability to adapt himself to his surroundings and to arise to emergencies should be determined.

One should be careful not to confuse cause and effect by attributing early symptoms to the production of the abnormal mental state, for example, the excesses of the paretic, the masturbation of the adolescent. Excessive indulgence in alcohol is sometimes one of the early symptoms of paresis, rather than the exciting cause. The possibility of intoxication should be considered, whether alcohol or other drugs have been used. The occupation of the individual and the material handled in his work should be noted.

Present Illness.—The determination of the actual time of onset is sometimes difficult to ascertain. This difficulty lies chiefly in the fact that many mental disorders have their beginnings marked by slight changes in disposition which are so insidious in their development they are not noted by persons associated with the patient at the time of their appearance. Very frequently in relating the history of the case, the statement is made that "in looking back over the matter" instances can be recalled in which the patient acted strangely, but were not noted at the time. The time of onset should be noted as accurately as can be done.

If there has been a previous attack, the character of the attack and the symptoms should be ascertained; also the duration of the attack, and whether or not the patient fully recovered.

Inquire whether the patient entertains any unusual ideas, whether suspicious, suicidal, homicidal or is in any way threatening in his attitude towards his family, wife, children and friends. Question in regard to any change in habits, temperament, character, morals, impaired intellectual capacity, indications of fear, excessive optimism, extravagance, talkativeness, unusual quietude, or depression of spirits. The effect of these upon the general body state

should be noted, as well as the influence upon sleep and the taking of food. Any recent physical disorder should be noted in detail, and its apparent effect upon the patient.

Physical Examination.—Examine the patient for physical signs of disease of the heart, lungs, kidneys, abdominal viscera, brain and spinal cord. In mental disease there may be a bodily disease which may exist without the patient being aware of it and may be masked by the mental symptoms. In consideration of the possibility of the patient being sensitive in the matter of undergoing a mental examination it is often well to begin with the physical examination.

The method of conducting the physical examination in general should be the same and as complete as when examining for purely bodily disease. There are, however, several physical signs which when present may have a direct bearing upon the mental disorder; they are the state of the general nutrition and the body weight; note the present weight compared with the former weight. A state of malnutrition with reduction of weight may have been present before the advent of the mental disorder, or as a result of a state of restlessness and sleeplessness, or abstinence from taking food. The presence of severe grades of anæmia and cachexia may indicate obscure malignant disease. Signs of premature senility or delayed pubescence, evidence of trauma and residual disease signs, especially syphilis and tuberculosis, should not be overlooked. The examination of the eye-grounds and media may reveal arterial sclerosis, which might not be visible in other peripheral vessels, and also latent or congenital lues. Visual disturbance may account for visual hallucinations. Likewise it is important to examine the ears in which a cause for auditory hallucinations may be found which otherwise would escape detection.

Examine the nervous system for evidence of gross brain disease, cord, and peripheral nerve lesions, and signs of disturbances of the sympathetic nervous system. No examination should be considered complete without noting the body temperature, in order to eliminate the possibility of acute infectious disease. Also, by exclusion, eliminate drunkenness, narcotism by chloral, opium or other drug effects, meningitis, apoplexy, or head injury.

Signs of Degeneracy.—The presence of any of the physical variations, the so-called "**stigmata of degeneration,**" should be noted. The most conspicuous morphological deviations from the normal are:

1. The cranium.
   - (*a*) Size and shape of the skull, the cephalic index and the facial angle.
   - (*b*) The ear.
   - (*c*) The eye.
   - (*d*) Hard palate.
   - (*e*) Teeth.
   - (*f*) Tongue, lips and nose.

2. Somatic deviations.
   (*a*) Skin and hair.
   (*b*) Anomalies of the limbs.
   (*c*) Giantism and dwarfism.
   (*d*) Genital anomalies.

In routine examination the measurements of the skull are taken with the calipers and steel tape. Three measurements are usually made as follows:

1. The Cranium

(*a*) The horizontal circumference is obtained by placing the tape over the arch of the eyebrows, and around the skull by way of the most prominent part of the occiput. The average circumference is assumed to be 50 cm. in women and 52 cm. in men, deducting 2 to 3 cm. for the thickness of the scalp. This may vary normally from 48.5 to 57.4 centimetres.

If the circumference falls below 46.2 cm., the condition is *microcephalic;* regular crania over 55.0 cm. are termed *kephalones.*

The greatest length is measured without regard to the horizontal plane, from the glabella to the external occipital point just above the inion; this measures, normally, in men 18.3 cm. and in women 17.8 cm. *A skull that does not measure more than 19 cm. or less than 16 cm. is considered normal.*

The greatest breadth is measured at the point of greatest width between the two parietal eminences. After deducting 5 mm., the average for the normal is 15.0 for men and 14.0 cm. for women; the normal limits are 13 and 16 centimetres.

Deformities of the skull are usually due to premature obliteration of the sutures, in which instance the bone prematurely ceases to grow at that point, and the skull is shortened in the diameter which is perpendicular to the direction of the obliterated suture. Other sutures not affected will allow the continued growth of the skull and the result is irregularity.

The macrocephalic skull usually due to hydrocephalus may be a result of faulty fœtal development. It may be the direct result of disease, as tubercular meningitis, ependymitis, obstruction of the veins of Galen or obstruction of the aqueduct of Sylvius, or formen of Magendie. Microcephalus results from early ossification of the sutures and the fontanelles, and is associated with idiocy, epilepsy, or cretinism. It may result from rachitis and imperfect development due to faulty nutrition.

(*b*) *The Ear.*—The shape and manner of implantation of the ear are apt to show marked variations from the normal in degenerates. It must be remembered that the perfect ear is not common; it "should be about twice as long as broad, and should be attached to the head al-

most straight or slightly inclined backward, and should touch the head with its upper point." * Many of the irregularities of the ear of healthy individuals, children especially, can be attributed to the carelessness of mothers and nurses. The deformities which are met in degenerates is the result of faulty development.

(*c*) *The Eye.*—Malformations and physiological defects of the eye occur in cases of degeneracy. These defects are not to be considered as an indication of such unless associated with other abnormalities. They are classed and enumerated by Peterson as follows:

Anatomical	Physiological.
Flecks of the iris.	Blindness.
Strabismus.	Myopia.
Chromatic asymmetry of the iris.	Hypermetropia.
Narrow palpebral fissures.	Astigmatism.
Albinism.	Daltonism.
Congenital cataracts.	Hemeralopia.
Pigmentary retinitis.	Concentric limitation of the visual field.
Microphthalmos.	Nystagmus.
	Muscular insufficiency.

(*d*) *The Hard Palate.*—Deformities of the hard palate have been the subject of systematic study by Peterson of which he examined more than a thousand, including criminals, idiots and other neuropathic individuals. The most frequent deformity is that in which the arch resembles in its formation the shape of the Gothic arch, and on this basis an architectural nomenclature has been adopted.

There are seven types of each. Peterson classes them as follows:

(*a*) Palate with Gothic arch—high or low, short or long.

(*b*) Palate with horseshoe arch—as in Moorish architecture.

(*c*) The dome-shaped arch—high or low; may be combined with symmetry.

(*d*) The flat-roofed arch—nearly horizontal, or flattened gable.

(*e*) The hip-roofed arch—marked pitch in front and behind.

(*f*) The asymmetrical palate—associated with facial asymmetry. asymmetry.

(*g*) The torus palatinus—swelling along palatine suture.

Abnormality of the palate has been observed in 10 per cent. of apparently normal persons, in 76 per cent. of epileptics; in 82 per cent. of idiots and feeble-minded; in 80 per cent. psychotics in general; in 70 per cent. of hysterical insane; and in 35 per cent. of general paralytics.

(*e*) *Dental Anomalies.*—Badly placed teeth, double row of teeth, macrodontism and microdontism, teeth with marked transverse or longi-

* Binder.

tudinal striations, and projecting teeth are the anomalies met with in association with other marks of degeneration. Hutchinson's teeth and caries are the result of disease and neglect. Dentition may be retarded, both in the first and second dentitions. Impacted third molars are commonly met.

(*f*) *Tongue, Lips and Nose.*—The tongue is frequently larger than normal in the low grades of idiocy, seen commonly in the cretin; in this class the lips are also large and puffy in appearance. Microglossus, asymmetry of the two halves, and a bifid tip also occur. Hair-lip is an associated malformation, but it also occurs without any other stigmata of degeneration.

Anomalies of the nose taken alone should not be considered as having any significance. The saddle nose may indicate injury or syphilis.

2. Somatic Deviation

Anomalies of the Skin and Appendages.—Evidences of anomalous development of the cutaneous structures appear either as insufficiencies or hypertrophies. There may be absence of pigment, as in albinism, vitiligo and premature grayness of hair, persistent lanugo and defects of development of the nails.

Hypertrophies are the more common, especially in the form of excessive amounts and abnormal distribution of hair, as on the chin and breast, in women; hair along the region of the spine; excessive pigmentation; pigmented and vascular nevi; ichthyosis and increase of panniculus adiposis, either local or general.

Anomalies of the Limbs.—In congenital paralysis there are deformities and retardation of growth; athetoses are due to localized brain disease, as is true of the idiocy which often accompanies that condition. Other anomalies do occur, however, which are to be taken as signs of hereditary degeneracy. They are supernumerary fingers and toes (polydactylism), fusion of fingers and toes (syndactylism), missing fingers and toes (ectrodactylism).

Anomalies of the Body.—Diminution of the figure (dwarfism) and excessive growth are often signs of degeneracy. Also, infantile characteristics in an adult, feminine traits in male and *vice versa.* Deviation of the spinal column, asymmetry of the thorax, absence of certain muscles, as the pectorals; excessive mammary development in males.

Genital Organs.—A common seat of structural anomaly is the generative apparatus. This irregularity in development may be marked by either insufficient or excessive development. Hypospadias, epispadias, median fissure of the scrotum, spurious hermaphroditism and imperforate meatus are the more common varieties in the male. In females abnormally large labia, nymphæ and clitoris are not uncommon. Imperforate vagina and atresia likewise may be present.

Mental Examination

The reaction type presented in any mental disorder is determined largely by interviewing the patient, unless he be in a state of excitement that prevents his attention being held, or if mute on account of delusion negativism or stupor.

In interviewing the patient the examiner, following the advice of the late Sir Thomas Clouston, should be perfectly frank, natural, honest and sympathetic. Listen to all he has to say as if he were a mentally well man. Do not irritate the patient, but rather endeavor to gain his confidence. Do not contradict him, to try to induce him to believe that his ideas are erroneous. Finally, try to lead him to believe that he is a sick man.

While listening to the patient's statements, note his general appearance and the state of nutrition; his manner, whether suspicious, exalted, depressed or mentally dull. Note the expression of the eyes, the character of the speech and the movements of speech organs and facial muscles, whether tremulous or incoördinate. In his conversation there may be evidence of delusions, or suspicion, or of altered feeling towards relatives, friends or employers. Question the patient concerning his physical health, but do not lay too much stress on the importance of his statements in that matter. The paretic may be in a dying state and yet strongly insist that he "never felt better" in his life. Depressed patients often state that they have not had a bowel movement for a week when there has occurred an action that day. Suicidal attempts and masturbation may be denied.

The determination of the mental status of the patient may depend almost entirely upon the ability of the examiner, for the reason that often the statements of the patient cannot be relied upon.

Occasionally the patients are quite ready and willing to detail their thoughts and experiences, which may be sufficient to enable to examiner to obtain a definite idea of the patient's mental state.

Several examinations are usually necessary for eliciting all the mental symptoms and to determine the part such symptoms play in the psychosis. It is well to make note of the questions asked, and also the answers given by the patient; these answers should be compared with the statements made at the preceding visit, the same questions having been asked at all examinations.

It is well for the examiner to follow a routine method of examination. This may be done in the order indicated in the description of mental symptoms (Chapter IX).

Disturbances of Perception.—Hallucinations and illusions can usually be elicited by directly asking the patient if he hears voices or sees objects, or has "visions." When abnormal sensations are not recognized by the patient such questions will naturally be answered in the negative. Hallucinations are not infrequently denied in spite

of their undoubted existence. A patient who complains of voices of his tormenters, whom he says are above the building throwing fire and acids down upon his head, when questioned as to whether he sees his enemies says: "You don't think I have hallucinations? They are real; go look for yourself."

On account of the frequent occurrence of hallucinations at night, the patient should be closely questioned concerning his sleep; if disturbed endeavor to determine the cause to which he attributes his wakefulness. If produced by the presence of hallucinations, the fact will probably be made known. Question him concerning daily experiences, his relations with friends, fellow shop-men, or business associates; whether he hears people talking about him, when he knows them to be absent. Such questions may elicit the presence of the symptoms sought.

Clouding of Consciousness and Disturbance of Apprehension.—The reaction which follows definite stimuli will determine the presence of disorder of the conscious state. The use of the same methods employed to determine the state of general sensibility will serve for this purpose. By pricking the skin with a sharp instrument, or by touching the body with a hot or cold object; in fact, any form of peripheral stimulation, even in states in which consciousness appears so clouded that there is no evidence of mental activity, may give rise to slight reactions, shown by a change of facial expression, an increased pulse or respiration rate, or slight movement of the body.

Auditory and visual tests may also be used, as by speaking sharply to the patient, or by bringing a bright light before the eyes. If consciousness is not greatly clouded, the use of written tests or color tests should be tried.

To test the ability to comprehend objects seen, simple or confused pictures placed before the patient may furnish further evidence of disturbance of apprehension.

Disturbance of Attention.—One must determine whether the attention is easily gained; if so, whether it can be held, or is feeble on account of distractibility. This can be done by the counting-test or, as it is called, the "one-hundred test." The patient is asked to subtract a given number from 100 and the preceding numbers successively down to 0; thus, 100—7, 99—7, 98—7, etc. This will give evidence of the presence of unusual degrees of mental fatigue; distractibility is determined by the interruption of the train of thought, as when some other stimulus is employed to divert the attention, such as the dropping of an object upon the floor. Allowances must be made for differences in attentive power in different individuals, which largely depends upon the social grade and the education of the patient (see Attention, Chap. V).

Memory Defects.—Defects of memory may involve a loss of recollection for either recent or remote events. Knowledge of the external world depends largely upon memories of past experiences. Common experience indicates that it is the rule that impressions re-

ceived most recently are the least easily retained in memory, while many impressions made in the earlier years of life are readily recalled, as, for example, the multiplication table. Not infrequently members of the family of the patient will volunteer such a statement: "But his memory is excellent; he can remember in detail happenings of years ago." This is often quite true, while if you ask that same patient what he had for his dinner that same day, he may not be able to say, or may not be able to tell whether or not he has had dinner.

For testing memory for past events, more or less remote, one may make use of the patient's statement of the history of the present illness; or question the patient concerning events or subjects, a knowledge of which is generally possessed by persons of the same social position and education.

Impressibility of memory can be determined by asking the patient to repeat words which are apt to be unfamiliar to him, or by directing him to write from dictation numbers containing several figures.

The *accuracy* of memory can be determined at the same time of questioning concerning remote events. A tendency to fabrication may also be detected at the same time.

The degree of education of the individual must furnish the guide to the selection of the questions asked.

Orientation.—To determine whether the patient is well oriented, ask the date of the month, the day of the week, and the season of the year. Question him concerning his surroundings, also the names of the persons about him and what are their duties and the patient's reason for occupying his position at that time.

Disturbance of Emotional Tone.—Prolonged alteration of emotional tone occurs in almost all psychoses. This may be increased, diminished or may be marked by emotional indifference to external stimuli. For a time, at least, it may be necessary to depend entirely upon the history of the development of the disorder, in regard to these symptoms, hence it is of great importance to learn as much as possible concerning the natural "disposition" of the patient. Often the disturbed emotional state represents an intensified normal, whether it be a condition of exaltation or of depression. Inquire of relatives and friends in regard to slight changes in the patient's attitude towards parents, husband or wife and children. A girl of sixteen years during the prodromal phase of her disorder confided to a neighbor that she did not love her mother. Is the patient now thoughtful of the wants of the family, or selfish and disrespectful? Is he careless in actions and speech?

Question the patient in regard to feelings of fear, sadness or a feeling of well-being. Such emotional states are usually depicted in the patient's facial expression.

Disturbances of the general feelings, such as pain, hunger, nausea

and sexual feelings, must be determined either by directly questioning the patient or by observing his actions.

With increased emotional irritability the patient usually shows emotional instability and increased motor activity; rapid changes in mood, accompanied by laughter or tears, anger or amenity, may all appear within a comparatively brief period, as in exalted and confusional states. In the latter, changeability of mood is usually controlled by the variable character of hallucinations.

Depression is commonly more or less continuous, with the exception of brief remissions accompanied by motor agitation. Simple depression of emotional tone is accompanied by retardation of the flow of ideas and motor sluggishness.

Abnormal sexual feelings are indicated by acts which may be carried on without the slightest evidence of feeling of shame.

Absence of the sense of hunger is common in patients who refuse food; the patient may say that he is hungry, but is afraid to eat. In states of excitement the feeling of fatigue may be absent for an incredibly long period, especially in paretics and in manic states.

Emotional indifference is characterized by the patient's inability to respond to stimuli that normally would excite his interest. Tears may be shed, but not in response to any appropriate stimulus. Simple questions may give rise to senseless laughter, and still the patient may be emotionally neutral in the matter of experiences which should normally give rise to reactions of joy or sorrow. The normal reaction which is aroused by the sight of food is one of the last to disappear in emotional deterioration.

Disorders of the Train of Thought.—During the examination for disturbances of perception and attentive power, disturbance of the train of thought may be revealed. This will be the case, especially if the patient answers promptly. Retardation of thought may be shown by delay or absence of answers; flight of ideas or persistent ideas expressed should be noted.

If the patient is not inclined to talk, or to answer promptly concerning matters connected with his illness, he should be questioned cerning recent events with which he should be acquainted.

Letters written by the patient are valuable aids in the determination of the mental status. Patients who have some reason for not telling of certain phases of their trouble may indicate in letters to members of the family evidences of disturbed train of thought.

The influence of association of ideas upon the train of thought as well as their content may be determined by asking the patient to write all the ideas which arise in his mind immediately after giving a "stimulus word."

A still more accurate method is the association test, which consists in giving a stimulus word for the purpose of arousing a definite train of thought, or better, a single idea, instructing the patient to instantly

express the first idea which comes into his mind, using single words in response. This procedure often gives the examiner evidence of the presence of fixed associations, and may indicate the prominence they gain in the mental life of the patient.

In the association test a number of words should be given, the "association word" being noted opposite to the corresponding stimulus word; the words should be arranged in columns so that they may be readily compared (see p. 112).

Disorders of Judgment: Delusion.—The presence of delusional ideas may be indicated by the attitude and bearing of the patient, especially when the delusions are based upon a sense of well-being.

It is usually necessary to question the patient closely in order to obtain direct statements or even suggestive remarks. Autopsychic and somatopsychic delusions may be elicited by questioning the patient in regard to his estimation of himself and his ability. This may give rise to expressions of ideas of either a grandiose or of a depressive character. For eliciting grandiose ideas question him in regard to his health, strength, physical development, wealth, personal accomplishments, skill or distinction. Depressive ideas may be brought out by similar questions in regard to the condition of the patient's body, mind or estate; unworthiness, poverty, disease, sinfulness, neglect of duty, impending punishment or calamity for wrong-doing. These may be partly expressed by the patient while the real content of the delusive idea remains unexpressed. A patient for a long time said nothing more than "Oh, I can not." When questioned in regard to her trouble later, she explained that she believed that she was responsible for all the deaths in the world and the condition of all the patients in the hospitals. Her expression meant to convey the idea that she could not endure the responsibility and that she "must be put out of the way." Allopsychic delusions are often secondary to the autopsychic type.

Persecutory delusions arise on the basis of emotional trends leading to ideas of superiority or personal inadequacy. The patient may believe himself the victim of conspiracy or plot on account of the jealousy of others because of his social position, wealth or personal superiority.

Ideas of personal inadequacy may be an outgrowth from delusion of sinfulness or poverty. Punishment thought by the patient to be in store for himself, he may believe is also to befall his family, or that destruction is to come upon the whole world as the result of his neglect or mistake. The patient who entertains ideas of exaltation usually expresses them freely and often unsolicited. The same is usually true of the patient who suffers from depression and ideas of personal inadequacy; depressed patients with suicidal tendencies may hide their delusions and also the tendency to self-injury. A patient may avoid touching objects, or may systematically try to prevent anyone from touching him, and yet never speak of the fear of being contaminated by dirt or disease, or of the danger of infecting others.

A patient held his urine and resisted the impulse to evacuate the bowels because of the fear that his excreta going into the sewer and the river would contaminate the entire population of the city.

Defective judgment without delusion can be determined by questioning the patient upon general matters in regard to himself, family and business. The character of the questions asked in all instances must depend upon the circumstances of the patient, his habits of life and his particular interests.

Disturbance of Volition.—Observation of the patient will be necessary from time to time in order to elicit true volitional disturbances.

The absence of voluntary movements will show the presence of paralysis of will, blocking of the will, psychomotor retardation and stupor. These and abnormal muscular conditions, such as increased muscular tension (cerea flexibilitas) and catalepsy will be brought to light during the physical examination. Negativism, stereotypy of speech and action and mannerisms are best elicited by commanding the patient to perform certain acts, such as handshaking, or attempting passive motion, such as flexion or extension of the limbs. In negative states the lips may be tightly pressed together when the patient is asked to open the mouth or put out the tongue. An attempt to passively open the eyelids is at once met by strong contractions of the orbicular muscles.

Hypersuggestibility of the will is demonstrated in patients exhibiting the catatonic syndrome. In this condition the muscular tension is somewhat increased; the limbs may not be moved by the patient voluntarily, and yet will remain in whatever position they are placed.

Diminished volitional activity is marked in depressed states, and is indicated by the appearance of effort exerted with every act. The consequence is that all acts appear painfully slow in their process of execution.

Blocking of the will is indicated by the patient's inability to carry acts to completion. Accompanying this is usually a state of increased muscular tension. Patients engaged in handwork may be observed with needle held up ready to be entered for the next stitch, but can be carried no further without a guiding hand to aid in the completion of the act. A spoonful of food on the way to the patient's mouth may remain held in the air for a long period.

Interference, stereotypy and mannerisms are indicated by the patient's performance of incongruous acts, the repetition of a single act many times, and the assumption of peculiar manner of speech, movement or attitude.

Conduct.—Conduct in general may be said to express the trend of mental activities. Disturbances of thought processes are commonly accompanied by irregularities of conduct, although no one unnatural act can be considered as sufficient evidence of the existence of a morbid mental state.

The conduct in mental disorder may be directed by the presence

of delusive ideas. An attempt at suicide is often the outcome of the belief on the part of the patient that he is a useless member of society, or that his existence is the cause of suffering on the part of others, or that he may escape suffering for sinful acts committed. Mental depression with anxiety is always indicated by restlessness, constant moaning, pulling at the clothes, picking the fingers, rubbing the hands or head, or pulling the hair. A depressed patient produced a bare spot on the side of her head by constant rubbing.

Abnormal degrees of irritability favor the development of mental excitement and loss of self control. The manic patient is careless in speech and reckless in conduct, not infrequently giving vent to acts of impropriety, or he even may become dangerously violent towards others.

The act of undressing is very common in acute mental disorders and in the demented types. A demented patient slips into his room, removes all his clothing, also the bed clothes, folds them all neatly, arranges them in a pile on the floor, then lies on the bare bed-spring or rolls himself up in the mattress.

Destructiveness is a common tendency in acute manical states. Thus, a patient tears his garments into ribbons which he hangs about the windows and bed and explains that he is decorating his "shop." Another patient tears his coat for the purpose of making it over in a better way. Hallucinations exert a marked influence over the patient's conduct; this is especially true in the matter of auditory hallucinations. Acts of violence are at times the result of commanding voices. A patient shot himself because he heard the voice of God telling him to do so, in order that he might be with the spirit of his deceased grandfather. Another patient was arrested in a restaurant for creating disorder, accusing the proprietor of putting poison in the food he had purchased. A third patient spits out or vomits her food because of a gustatory hallucination. She is constantly tormented by obnoxious gases in her body, which she says she can taste and smell at all times, so that every attempt to eat gives rise to a reaction of disgust with a feeling of intense nausea. Homicidal assaults are sometimes the direct result of commanding voices heard; for the same reason attempts at suicide are made. Under the delusion that he is persecuted and followed wherever he goes, the paranoiac may wander from town to town, working for a short time in one place, but only until he finds that he is persecuted by his fellow-workmen. Other patients write letters to prominent persons, demanding their rights; or to government officials claiming that the country owes them a living; books and pamphlets are written in order that the "calling" of the individual may become known to the world.

Some acts performed are the result of an irresistible impulse, of which the patient may be conscious, although not necessarily cognizant of his acts. Such acts are termed "impulsive" acts and include the

impulse to destroy objects near at hand; to burn—pyromania; to steal—kleptomania. The impulse to wander from home for the reason of a desire to throw off the influence of home or social restraint is common in the early phase of dementia præcox.

Monotonous repetitions of acts are common in dementia præcox. These usually consist of definite rhythmic movements of the muscles of the face or extremities, or in the repetition of words or phrases. Sometimes the words spoken (echolalia), or the movements of others, are repeated by the patient; the latter phenomenon is known as **echopraxia.** There may be a conspicuous absence of speech or movement in some cases of dementia præcox and states of depression. Mutism may be based upon delusion; thus a patient feels that it is a sin for him to speak, but will make his wants known in writing. Another patient does not speak because he believes that he is without speech organs, or fearful that by speaking he will injure someone else. This forced mutism is termed "mutacism." In dementia præcox mutism is commonly associated with the negativistic state.

The opposite condition is seen in the loquaciousness of acute manias, delirium tremens, paresis and the manic phase of manic-depressive psychoses.

On account of the delusion that attempts are made to poison the patient he may refuse food, or, as occurred in the case of one patient, only certain articles of food are refused, such as soups and desserts, believing them alone to contain poison. Food may also be refused for suicidal reasons. One patient argues, "I have committed a great wrong which can never be righted; therefore, the sooner I die the earlier will I be relieved; so I will not eat."

Grinding of the teeth occurs in acute delirium and in the later stages of paresis and dementia præcox. Champing of the jaws is seen in the agitated forms of depression and in paresis.

Patients with grandiose ideas, without regard to their assets, may arrange for the outlay of large sums of money for great and even impossible financial undertakings, to the embarrassment or even crippling of business associates. Excessive and improper sexual indulgence is not uncommon in paretics before the disease has been recognized. One patient called up on the telephone prominent women of his town and made improper proposals to them. Acts of indecency are perpetrated without regard to the place or persons present. Excessive indulgence in alcohol is not infrequently an early symptom of the prodromal phase of mental derangement.

Sudden changes in the manner of conduct are more apt to take place in the acute forms of mental disorder. This is shown by mental irritability and quarrelsome tendencies, usually aggravated when an attempt is made to restrain the patient's acts. Many patients in the beginning of a psychosis conduct themselves as if they were intoxicated. Some paretics and precocious dements are unusually good-natured and show

an exaggerated degree of friendliness towards persons about them, and even towards strangers.

The patient's belief that he is a prominent personage may lead to an uncommon and conspicuous mode of dress, or the adornment of the clothing with brilliant colors or decorative ornaments, in order to attract the attention of others. This procedure common among the paranoidal psychoses has been affected by individuals feigning mental disorder.

Disturbances of Expression Including Speech and Writing.— The expression of thoughts in the countenance and the manner of speech and writing, as well as their content, are valuable aids in the study of mental disorder. The facial expression usually denotes whether the patient is in a state of terror, or is mentally dull, gloomy, self-absorbed, elated or demented. There may be an entire absence of facial expression; the muscles are in such instances lax, the eye has a vacant look, the mouth is either closed or open, while the jaw is allowed to drop. Such expressions are seen in the idiotic, demented, melancholic and catatonic condition. The mobile countenance, on the other hand, with constant play of the facial muscles, is common in the acute and chronic manic states, paresis and some cases of dementia præcox. These patients show that there is more or less constant mental excitement, often indicating the presence of pleasurable sensations, the eyes are bright and in constant motion with the play of the facial muscles. In some instances of chronic depression in which facial muscular activity is maintained there exists a state of muscular tension so that the forehead shows prominently longitudinal and perpendicular wrinkling, on account of the permanent contraction of the frontalis and corrugator muscles; the mouth is closed and the angles of the mouth are drawn down; the eyes are lustreless and downcast, and the mucosæ of the lids and conjunctivæ are dry.

The suspicious countenance is often combined with anxiety and is of more or less constant tension. Such patients may be continuously on the lookout for annoyances or impending calamity; those suffering from visual hallucinations may acquire a fixed but not vacant gaze, or an expectant expression, as would those with auditory hallucinations in listening for voices.

Other types of muscular hyperactivity are often characteristic in mental disorder. In the dementia præcox type the movements are stiff and awkward; the stiffness is especially characteristic on account of the increased muscular tension. The general bodily movements are those of the careless and slovenly habit.

Ideas are formed and retained in consciousness largely by the aid of language; in fact, a point is reached in mental development when language is necessary for further mental advancement.

It is nevertheless possible for persons who have acquired speech and who have subsequently been deprived of articulate speech (motor

aphasia) to retain the ability to form ideas, as may be indicated in writing.

Deaf-mutes are able to rapidly convey ideas and describe experiences in pantomime and the mute language. Upon close examination of the expressed ideas it will be found that many of the ideas are primitive in character and are incomplete. This is very marked among the less educated deaf-mutes, shown by the absence of connecting and qualifying words and phrases.

In mental disorders speech is often involved, and in varying degrees and kinds of disorder depending upon the type of mental disturbance.

Laboratory Diagnostic Methods

In psychiatric practice, as in general medicine, the diagnostic chain is not regarded as complete without the application of available laboratory methods. In all cases in which a definite history of luetic infection has been elicited, the Wassermann test is applied with the view of determining, if possible, the effect of anti-luetic treatment, or the presence of syphilitic residua in cases in which other manifestations of the disease are absent, or in cases in which there is doubt as to the possibility of infection.

The Wassermann test is applied in psychiatry as a routine procedure in the examination of all patients, for the same reason as in general medicine, and, in addition, as an aid in the determination of the rôle played by luetic infection in the production of the psychosis in question.

With the occurrence of a psychosis in a person who has been infected with syphilis several possibilities arise for consideration.

1. The psychosis, occurring in a person unstable by constitution, may bear no relation to the luetic infection, as, for example, when dementia præcox or manic-depressive psychoses occur in a syphilitic.[4]

2. The psychosis, occurring in a person constitutionally unstable, may arise as the result of the mental shock to the patient following the knowledge of the fact that he has syphilis; for example, psychasthenic states.

3. A psychosis may develop as part of the toxic syndrome produced by the constitutional effect of the syphilitic infection.

4. Psychoses may appear as the result of gross cerebral lues, either gummatous or meningitic.

5. Mental deterioration following apoplectic softening may be the result of syphilitic arterial disease.

6. The mental symptoms and physical signs of paresis occur as the result of parenchymatous syphilis of the central nervous system.

With the above possibilities to be considered in the study of every psychosis, the application of a laboratory procedure which will aid in the determination of the presence of a syphilitic factor, either latent or active, becomes indispensable for purposes of differential diagnosis and prognosis.

The Wassermann Reaction.—This reaction has come out of the application of the Bordet-Gengou principle known as the phenomenon of inhibition of hemolysis.

Hemolytic power is usually possessed normally by the blood serum of some animals against erythrocytes of an animal of different species.

It has been found that by carefully increasing the amount of foreign erythrocytes introduced, the animal thus treated will develop specific hemolytic antibodies, accompanied by a marked tolerance for the foreign substance; thus, if washed blood corpuscles are injected into the peritoneal cavity of an animal of different species, at intervals of several days, beginning with 2–3 c.c. and slowly increasing to 10–20 c.c., the serum of the blood of the injected animal develops the power to destroy or dissolve the corpuscles of the foreign blood. The animal is therefore said to be *immunized* against the particular species of blood corpuscles. Experience indicates that the rabbit-sheep combination is most favorable for practical purposes. A rabbit injected with sheep corpuscles may develop a specific hemolytic substance against sheep cells, which can be demonstrated *in vitro,* by adding fresh serum of an immunized rabbit to the sheep erythrocytes. Hemolysis takes place in a short time, leaving a clear hemogloblin-tinged serum.

The essential factor in the hemolytic process appears to be an antibody or specific hemolytic substance (hemolysin). This substance is not the only factor necessary for hemolysis, as can be shown by heating the immunized serum to 56° C. for 30 minutes, which destroys the hemolytic action or inactivates the serum. The serum may again be made active by the addition of serum from a non-treated or normal animal, indicating that blood serum normally contains an essential element, the **complement,** which is easily destroyed by heat.

The hemolytic power of the serum of an immunized animal, therefore, depends upon the presence of two substances, one the more stable, heat-resisting hemolytic antibody, and the other unstable substance—the complement. Both of these are essential to the production of hemolysis. The following essential elements, therefore, constitute a "hemolytic system":

Blood corpuscles + complement + specific (hemolytic) amboceptor = hemolysis.

A substance which gives rise to a reaction producing a hemolytic amboceptor when introduced into the body of a susceptible animal is known as an **antigen.** In the rabbit-sheep hemolytic system the sheep corpuscles (antigen) are employed to stimulate the production of the antibody.

We have already seen that hemolysis may be inhibited by heating the serum to 56° C. It has been shown by subsequent research that inactivation, fixation or absorption may be brought about *in vitro.* Thus the inhibition of hemolysis may take place when the complement, normally present in the blood, comes in contact with the amboceptor in the

presence of proper antigen. In such instances the complement is said to be absorbed or "fixed." This principle, evolved by the work of Bordet, and applied by Wassermann and his coworkers in an attempt to find specific antibodies in infections, particularly syphilis, is known as the "complement fixation test," or the Wassermann syphilitic reaction.

In order to carry out the procedure as originated by Bordet it would be necessary to employ as antigen a preparation made from pure cultures of the *treponema pallidum*. As these were not available at the time the original work was done, the test was conducted with the employment of either watery or alcoholic extracts of organs of individuals known to be syphilitic and to contain treponemes. Subsequently it was found that extracts of normal organs, notably heart muscle, were sufficient to fix the complement with a syphilitic amboceptor, and still later, in 1907, it was learned than an alcoholic extract of organs used gave better results than watery extracts, which led to the conclusion that the antigen was an alcohol soluble substance subsequently found to be lipoidal in nature. As a result of these observations and subsequent investigations it was concluded that the fixation in syphilis reaction was not due to a specific luetic antigen, but to the presence of certain tissue products of the activity of the treponemes; in fact, the Wassermann reaction, as far as is known, is an indication that a chemical change, depending upon the chemistry of the lipoids, has taken place in the tissues of the syphilitic as the result of the activity of the treponemes.

In the test for the Wassermann reaction for syphilis the following agents are required:

1. Hemolytic amboceptor.
2. Complement.
3. Washed erythrocytes.
4. Antigen.
5. Fluid to be tested (serum or spinal fluid).

1. Hemolytic Amboceptor.—The hemolytic system usually used is that which has for its basis the anti-sheep hemolysin or amboceptor. This is obtained by injecting a rabbit under strict asepsis with washed sheep erythrocytes. Sheep blood previously defibrinated by whipping or shaking with glass beads in a tube for about five minutes is subsequently washed by thoroughly mixing with sterile normal salt solution and centrifugated, pouring off the supernatant fluid and removing the salt solution for about three times in order to remove the serum.

The prepared corpuscles are injected into the marginal vein of a rabbit's ear or into the peritoneal cavity. One to five c.c. of washed erythrocytes are injected, the dose being increased to 10 and 20 c.c. at subsequent injections, which are made at intervals of one week or ten days. From three to four injections usually are sufficient. The first injection of 1–5 c.c., the second of 5–10 c.c., and a third of 10–15 c.c. are commonly employed. A fourth injection of 20 c.c. may be used if required.

It is a good procedure to draw a little blood after the third injection to test the hemolytic power of the serum, in order to avoid a fourth injection if possible, as the animal is now more likely to succumb either to anaphylaxis or an accidental infection.

An immunized rabbit serum of which 0.1 to 0.2 of a 1-100 dilution in normal salt solution, in the presence of a proper amount of guinea-pig serum, being capable of hemolyzing 1 c. c. of 2.5 suspension of sheep corpuscles may be regarded as a satisfactory hemolytic serum. After standing a few hours the serum is drawn off with a pipette, diluted with an equal amount of glycerine or a 0.3 per cent. of tricresol and stored in an ice box in sealed ampoules containing not more than 2 c.c. each.

2. **Complement.**—Experience has shown that guinea-pig serum is best suited for the purpose of the test because of the large complement content. The serum should be obtained from healthy animals by severing the vessels on both sides of the neck of an anesthetized animal. The blood is collected in sterile tubes and allowed to coagulate. The clot is then separated from the walls of the tube by passing a thin glass rod between the clot and the tube, and centrifugated until the serum is perfectly clear and free from corpuscles. The serum is drawn off with a chemically clean sterile pipette, and preferably is used the same day, or it may be stored in the ice chest if wanted for use the following day.

3. **Washed Erythrocytes.**—Sheep blood which has been defibrinated is washed in sterile normal salt solution to remove all traces of serum as previously described for the preparation of the sheep blood for injection of the rabbit. The blood may be obtained from the abattoir the day it is to be used, or kept in the ice chest, without the addition of any preservative, if used within three days. A 2.5 per cent. suspension of sheep corpuscles is commonly employed in the test, of which 1 c.c. is used, the corpuscle suspension being prepared with 8.5 per cent. of sodium chloride in distilled water.

4. **Antigen.**—As stated under the discussion of the fixation reaction it has been found that alcoholic extracts of organs serve well as antigens on account of their lipoidal content, but these are not specific. Even extracts of *treponema pallidum* do not serve as well as do the antigens made from extracts of organs. It has been generally accepted that an alcoholic extract of liver of a syphilitic fœtus comes nearest to being a specific antigen, although strictly it is not, for the reason that as Noguchi has shown, alcoholic extracts of the pallida do not serve as well as watery extracts made from the organisms.

Antigenic substances such as extracts made from beef or guinea-pig heart are rendered more sensitive by "reinforcement" by the addition of cholesterin to the alcoholic extract.

The ordinary alcoholic extracts of antigenic substances, such as normal heart muscle, contain fatty substances, fatty acids, soap and soluble proteid substances which inhibit the normal effect of the comple-

ment and thus prevent hemolysis. Such a substance is said to have an "anticomplementary" effect and is of necessity to be avoided in order to prevent reactions which appear to be "positive" with fluids which should test out negative.

To overcome this, Noguchi recommended the employment of that part of the antigenic extract which is not taken up in solution by acetone, and is known as the "acetone-insoluble-lipoid" fraction.

Both the reinforced antigens and the acetone-insoluble-lipoid extracts are often found to be more sensitive than the plain alcoholic antigens, and the result should be interpreted accordingly.

It is the practice of many technicians to employ as a routine three antigens at the same time, in which instance each antigen serves as a control over the other two when the results of the reactions are read.

5. Fluid to be Tested.—The complement fixation test, as employed in psychiatry, is applied to the examination of the blood and the cerebrospinal fluid. For the collection of the specimen of blood are required a sterile test tube 12 m.m. x 100 m.m., preferably without a lip, a hollow needle about two inches long and of a calibre known as 19 gauge and a suitable tourniquet. Blood is conveniently drawn from one of the superficial veins just below the bend of the elbow. The bandage is applied above the belly of the biceps muscles and fastened in such a way that it may be loosened quickly when it is desired to stop the flow of blood. After the application of the turniquet the vein will come into prominence as the result of the retarded flow of blood in the vessel.

Selecting the patient's left arm as the more convenient to manipulate the left thumb of the operator is placed over the vein just below the proposed point for puncture, in order to prevent the vein from slipping away from the needle-point, and also to serve as a guide for insertion of the needle. The point of the needle with the bevel side of the point directed upward is quickly inserted into the vein as close as possible to the tip of the fixing thumb of the operator. The needle should be rapidly directed inward and, without interruption, upward along the course of the vein. If the blood does not flow through the needle, it will be because the vein has not been entered, or its walls have been transfixed, or, if the penetration has not been executed quickly enough, is probably due to the formation of a clot within the needle. Failure to apply the tourniquet tightly enough, abnormally weak pressure of blood in the vessels, small veins, and a large amount of panniculus are factors which may make a comparatively simple operation difficult. It is important to secure sufficient blood in case more serum should be required in the manipulation of the test. The blood should be drawn under aseptic precautions, cleaning the site of vein puncture, and painting the skin with iodine before inserting the needle and after drawing the blood. The wound should be protected with collodion or a strip of sterile gauze for 24 hours.

The tube containing about 6 or 7 c.c. of blood should be closed with a sterile cotton plug and allowed to coagulate at room temperature, and later placed in the ice chest. Sera which are not to be examined the same day are best preserved when separated from the clot. Sera that are too old become anticomplementary, but undergo that change less rapidly when free from hemoglobin. The safest procedure is that of examining the blood the same day that the specimen has been taken, but it may be stored on ice for three or four days.

Spinal Fluid.—To obtain a specimen of the cerebrospinal fluid, one employs the method of lumbar puncture, carried out under rigid aseptic measures to avoid the serious accident of infection of the intrathecal space. The technic usually employed is the following: The patient lies on the right side with the legs and thighs strongly flexed and the chin brought as near as possible to the knees, thus separating the laminæ of the vertebræ so as to widen the intervertebral spaces as much as possible. The space between the fourth and fifth vertebræ is selected for the point of making the puncture, normally found on a line drawn across the upper level of the iliac crest.

The introduction of the needle, which should be longer than that used for blood collection, is made at a point about 6 mm. to the side of the spine of the vertebra and a trifle below it. The needle is introduced in a straight line and should enter the intrathecal space before meeting with any obstruction. Should the needle come in contact with the bone, it should be immediately withdrawn and another needle should be tried in order to avoid delay of cleaning the needle again.

As soon as the intrathecal space has been penetrated, the spinal fluid should flow, or, as is usually the case when the pressure is not great, drops rapidly from the mouth of the needle. Preparation should be made to collect the fluid in two sterile tubes, as the first few drops may be blood-stained, which is undesirable. After allowing 7 or 8 c.c. of spinal fluid to escape, the needle is quickly withdrawn and the point of puncture covered with collodion or other suitable sterile dressing.

Contraindications and Precautions.—Usually the operation of lumbar puncture in skilled hands is not followed by untoward effects. It is generally regarded as contraindicated in patients with brain tumor or those who are in a greatly reduced physical condition; if the operation is performed in such instances a small quantity (2 c.c.) only should be drawn. In all instances the safest plan is to keep the patient in bed until the day following the lumbar puncture.

Should the procedure prove to be a "dry-tap" it is better not to repeat the attempt at the same sitting.

Some patients suffer from headache, vomiting, or diarrhœa, as a result of the sudden diminution of the intracerebral pressure. Rest in bed is indicated until the subsidence of the symptoms.

The principal precaution is the employment of strict surgical cleanliness for the hands of the operator, the puncture needle and the site of operation.

The fluid obtained should be examined as soon as possible on account of the deteriorating changes which are liable to occur.

The Technic of the Wassermann Test.—As previously stated, the substances required for the test are: hemolytic amboceptor, complement, antigen, sheep-corpuscles and the fluid to be tested.

The amount of each ingredient employed may be approximately stated thus:

1. Hemolytic amboceptor, ½–2 units, as determined by titration.
2. Antigen, 1 unit, as determined by titration.
3. Complement, 1 unit (1 c.c.) of 1.20 dilution in normal (8.5 per cent.) salt solution.
4. Sheep erythrocytes, 1 c.c. of a 2.5 per cent. suspension in salt solution.
5. Patient's serum, 0.1–0.2 c.c. As a routine procedure 0.1 c.c. is commonly used for the test.

The titration of the amboceptor and antigen must be carefully carried out in order to determine the dose of each required in the test. The amboceptor should be titrated before every series of tests, on account of the fact that a new supply of sheep cells is employed for each series of reactions; the antigen should also be titrated from time to time, in order to keep check on any deterioration in its strength.

Amboceptor Titration.—A unit of sheep amboceptor is that quantity of rabbit serum immunized against sheep blood, which in the presence of one unit of complement (½–1 c.c., 1 : 20 dilution of guinea-pig serum), together with 1 c.c. of sheep-cell suspension, will produce **complete hemolysis** of the erythrocytes in ¾–1 hour in a water bath or incubator at 39° or 40° C. The titration is carried out as follows:

Arrange a series of tubes in a rack, marking on each tube the amount of amboceptor to be received. Add to each tube in the series ascending doses of the immune rabbit serum to be titrated, after diluting 1 : 20 with salt solution as follows:

Tube 1	0.01 c.c.	Tube 6	0.10 c.c.
Tube 2	0.02 c.c.	Tube 7	0.15 c.c.
Tube 3	0.03 c.c.	Tube 8	0.20 c.c.
Tube 4	0.04 c.c.	Tube 9	0.25 c.c.
Tube 5	0.05 c.c.	Tube 10	0.30 c.c.

If the immune serum should be rich in amboceptor, a dilution of 1 : 100 may be made instead of 1 : 20, the procedure otherwise is the same as above.

Add to each tube 1 unit of complement and 1 c.c. of the erythrocyte suspension. To each tube sufficient normal salt solution is added to make the volume equal to about 4 c.c.; all the tubes should be shaken

and placed in the water bath for ¾–1 hour at 39°–40° C. The first tube which shows complete hemolysis will indicate the dose of amboceptor which is to be used as the unit. Thus, if tube No. 6, containing 0.1 c.c. of amboceptor, is completely hemolyzed, the dose will be ½–2 units, or 0.15 to 0.2 c.c. as determined by the titration.

Antigen Titration.—As in the titration of the amboceptor a series of 10 tubes are arranged in the rack. Dilute the antigen with normal salt solution in the proportion of about 1 : 20. Ascending doses are added to the tubes, thus:

Tube 1	0.05 c.c.	Tube 6	0.30 c.c.
Tube 2	0.10 c.c.	Tube 7	0.35 c.c.
Tube 3	0.15 c.c.	Tube 8	0.40 c.c.
Tube 4	0.20 c.c.	Tube 9	0.45 c.c.
Tube 5	0.25 c.c.	Tube 10	0.50 c.c.

To each tube 0.1 c.c. of known syphilitic serum is added, together with one unit of complement.

Treat another set of tubes in the same way, using normal or non-syphilitic serum. Add normal salt solution to all the tubes to make the volumes equal, shake and incubate for ¾–1 hour at 39°–40° C. The tubes should be shaken from time to time during the incubation. At the end of the period of incubation add the hemolytic system, namely 1 c.c. sheep cell suspension, and one to two units of hemolytic amboceptor, and add enough salt solution to make about 4 c.c.; shake the tubes and incubate again for ¾–1 hour.

At the end of the incubation examine the series of tubes containing the syphilitic serum, and the tube showing complete inhibition of hemolysis will indicate the unit of antigen. Thus, if tube "No. 4" in the above series does not show any trace of hemolysis, the unit of antigen to be used for the test will be 0.2 c.c., diluted in the proportion of 1 : 20.

Next, examine the tubes containing the normal serum. The tube which shows any inhibition of hæmolysis will indicate the anticomplementary dose of the antigen. *The unit of antigen to be used for the Wassermann reaction should be the amount which shows complete inhibition of hemolysis with the syphilitic serum, but which at the same time shows no trace of inhibition in the corresponding tube containing the normal serum when twice the antigenic dose is used.*

If the antigen proves to be anticomplementary it is unfit for use, for the reason that it inhibits hæmolysis in specimens of non-syphilitic blood.

Technic for the Application of the Reaction.—In order to economize time it is customary to examine a number of sera or spinal fluids at the same time. A rectangular wire rack, which will accommodate about seventy-five test tubes, can be conveniently used in a water bath so that ten different blood specimens may be examined at the same time, with the use of three antigens, and also accommodate

a row of control tubes. Tubes 12 x 100 m.m. are of convenient dimensions for manipulation.

All sera to be examined at the same time should be inactivated together by heating at 56° for 30 minutes in a water bath. Spinal fluids do not require inactivation.

Each unknown serum is tested against a known positive and a known negative control serum.

Fresh positive and negative control sera should always be carried along with the fluids to be tested for the reason that even in the hands of skilled technicians unforeseen errors may occur, either through contamination or deterioration of the agents employed, thus resulting in false readings.

Beginning at the left hand lower row of the test tube rack, the tubes are arranged in a series commonly indicated as the " front row " series, in which the sera employed are tested for " anticomplementary " effects by adding to 0.1 c.c. of serum, 0.05 or 1 c.c. of 1–20 dilution of guinea-pig serum and salt solution (8.5 per cent.) added to bring the amount to 4 c.c.

To the rear tubes are added the same quantity of patient's serum and one unit of the antigen diluted, according to the proper dosage previously determined by titration, and 1 c.c. of complement, diluted 1 : 20 with sufficient salt solution to make the volume equal in all tubes to about 4 c.c.

A control tube containing 1 c.c. sheep corpuscles in salt solution is carried in the rear of the rack for the purpose of gauging the normal stability of the corpuscles used in the test. Another control tube carries 0.1 c.c. of the patient's serum, 1 c.c. of the erythrocyte suspension and 1 to 2 units of amboceptor to test the inactivation of the serum.

The rack containing the tubes is placed in a water bath or incubator at 37° C., where it is allowed to remain ¾ of an hour. At the end of this period 1 c.c. of a 2.5 per cent. suspension of sheep corpuscles is added to all the tubes containing sera to be tested, and the hemolytic amboceptor in the proper dosage, 1.5 to 2 units as previously determined by titration.

The tubes are now individually shaken, care being taken not to contaminate one tube with any of the contents of another tube.

The rack of tubes is now returned to the water bath for a period of one hour, during which they should be occasionally shaken. Usually before the end of an hour the negative tubes will show complete hemolysis, provided the sera or antigen are not anticomplementary.

The front row of tubes is inspected to determine any anticomplementary action of the sera; these tubes should be completely hæmolyzed, and, should there remain any unhæmolyzed cells in the front row, the test should be repeated with fresh patient's serum.

During this preliminary incubation the complement, in the presence of sufficient amboceptor (when present) and the antigen, is absorbed or fixed.

In careful hands with well-guarded controls the Wassermann reaction is a valuable confirmatory test as an aid in diagnosis, but in no instance should it be used as a sole guide in the diagnosis, or be allowed to bias the mind of the diagnostician when sufficient clinical data are wanting (p. 197).

The Reading of the Result.—A typical positive Wassermann reaction is that in which there has been a complete inhibition of hæmolysis in all three tubes containing the different kinds of antigen; a typical negative reaction is that in which hæmolysis is complete in all the tubes. It may happen, however, that a positive reaction may only

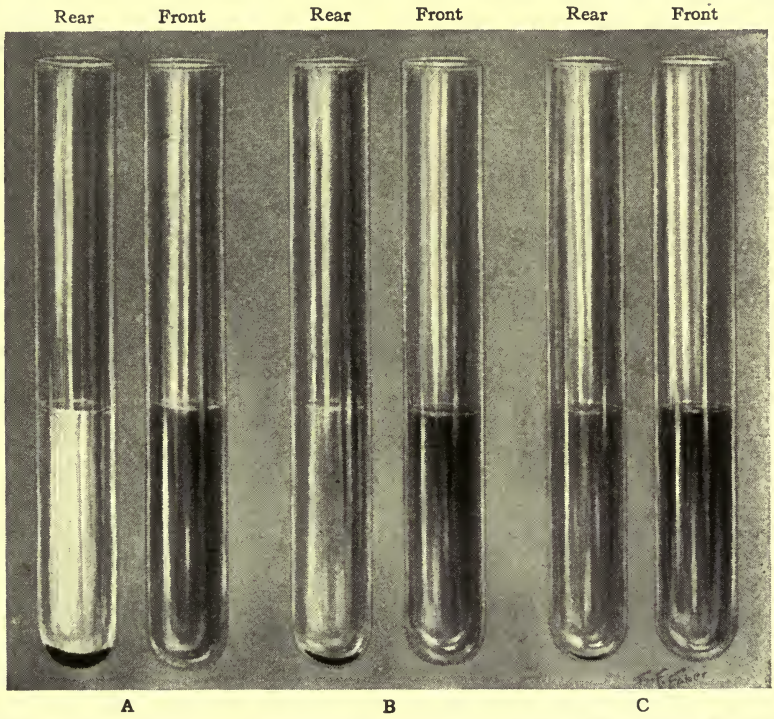


FIG. 63.—Wassermann test, showing the reaction. A, strongly positive; B, positive; C, weakly positive. All front tubes completely hemolyzed.

show partial inhibition of hæmolysis, that is, only a part of the erythrocyles may become hæmolyzed. On this account it is customary to read the result as follows:

Complete inhibition—4 plus.

When the hæmolysis is slight and ⅔ of the erythrocytes remain—3 plus.

When only ½ of the erythrocytes are hemolyzed—2 plus.

When hæmolysis is almost complete but ¼ of the erythrocytes remain unhæmolyzed—1 plus (Fig. 63).

Spinal Fluid Cell Count.—In paresis, cerebral lues and syphilitic meningitis, the lymphocyte count is an important aid to diagnosis.

For this purpose a white blood corpuscle pipette and a counting chamber are required, as in making a blood cell count. The Fuchs-Rosenthal chamber is the most convenient type employed on account of the method of ruling being especially well adapted for the purpose (Fig. 64).

The cells are stained by adding to the diluting fluid a small amount of anilin nuclear dye as in the following solution:

Methyl violet	0.1 gm.
Glacial acetic acid	2.0 c.c.
Distilled water	50.0 c.c.

The capillary tube of the mixing pipette is filled with the staining solution to the mark 1, and the spinal fluid which has been well shaken is drawn into the pipette until it reaches the mark 11. The fluid in the pipette is then thoroughly shaken for several minutes. The diluting fluid not only stains the lymphocytes but at the same time decolorizes any erythrocytes which might be present. The first few drops which have not reached the mixing chamber are discharged from the capillary part of the tube, after which a drop is expelled for the count, in the same manner as an ordinary blood-corpuscle counting chamber.

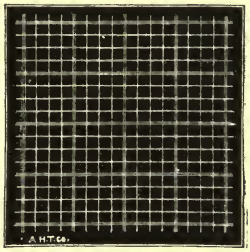


FIG. 64.— Fuchs-Rosenthal ruling in counting chamber of slide for spinal-fluid cell count.

The ruling of the chamber is such that the squares are larger than in the hæmocytometer ruling. The counting chamber represents a capacity of 2.88 c.m.m., and consequently the number of cells per cubic millimetre will be the number of cells found divided by 2.88. If the number counted exceeds 5 per c.m.m. the result is regarded as doubtful; more than 10 regarded as positive, and less than 5 negative.

Colloidal Gold Reaction.—The test has for its basis the precipitation of colloidal gold from solution in the presence of protein in amounts which abnormally occur in the spinal fluid, especially in paresis and tabes dorsalis and syphilis of the nervous system. The reaction in the spinal fluid is peculiarly different in the three classes of disorders of the nervous system.

The technic of the test and especially the preparation of the reagents require extreme care and cleanliness.

All solutions are made with double distilled water to insure chemical purity, and the employment of apparatus without rubber connections.

The solutions required are:

1. 1 per cent. solution of gold chlorid.
2. 2 per cent. solution of potassium carbonate.
3. 1 per cent. solution formalin.
4. 0.4 per cent. solution sodium chlorid.

To prepare the gold solution the distilled water used is first heated in a flask to 60° C., after which 1 c.c. of a 2 per cent. potassium carbonate solution is added for every 100 c.c. of water, followed by 1 c.c. of 1 per cent. gold chlorid solution, and the whole brought rapidly to the boiling point. As soon as boiling has begun, the flask is removed from the flame and 4 c.c. of a 1 per cent. solution of formalin is added, a few drops at a time, shaking the contents frequently until a clear deep red color of the solution is obtained, which should be free from bluish cast.

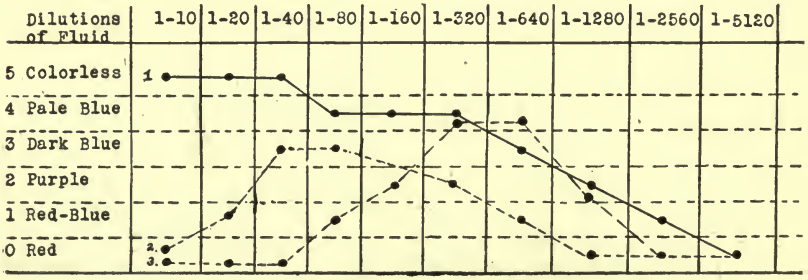
In conducting the test a rack carrying ten tubes, each containing a 0.4 per cent. solution of freshly prepared sodium chlorid is employed. Of this solution 1.8 c.c. is placed in the first tube and 1 c.c. in each of the remaining nine tubes.

In the first tube 0.2 c.c. of the spinal fluid to be tested is added and thoroughly mixed to make a 1 : 10 dilution. Of this dilution 1 c.c. is transferred to tube No. 2, and the same repeated with each of the succeeding tubes so as to make a series of dilutions, *viz.*, 1 : 20, 1 : 40, 1 : 80, 1 : 160, etc., up to 1 : 5120. The volume of the last tube must be reduced to that of the other tubes by the removal of 1 c.c. of the mixture.

The gold chlorid solution is then added in 5 c.c. amounts to each tube, and the tubes promptly shaken and allowed to stand for 24 hours at ordinary room temperature (22° C.). The readings are made in strong daylight and recorded in terms of the following colors represented by figures thus:

No. 0—The original color—red.
No. 1—Red-blue.
No. 2—Lilac or purple (blue-red).
No. 3—Dark blue.
No. 4—Pale blue.
No. 5—Colorless—complete precipitation.

The results are usually expressed diagrammatically, which may be indicated as curves which are characteristically different in the three types of nervous syphilis and are termed: (1) the paretic curve, (2) the syphilitic curve and (3) the meningitic curve, as represented in the following chart (Potter):



Nonne-Appelt Globulin Test—Phase I:

The so-called " Phase I " reaction is employed for the detection of albuminous bodies in the cerebrospinal fluid, especially for the determination of presence of increase in the globulin content.

To carry out the test, 1 c.c. of a hot saturated solution of ammonium sulphate, which has been allowed to cool, is added to 1 c.c. of cerebrospinal fluid. The fluids are carefully brought into contact by overlaying one fluid with the other. A distinct gray ring occurs at the zone of contact if the globulins are increased. The fluids are next thoroughly mixed by shaking and the result is to be noted in about three minutes. A distinctly cloudy or opalescent mixture is read as a positive " Phase I " reaction.

Although the " Phase I " reaction may be found positive in all organic affections of the nervous system, and it is regarded as being present in almost every case of paresis, it is never found, according to Nonne, in persons who have been infected with syphilis, but who do not suffer from organic nervous disease. The reaction is of value in the determination of whether a patient, known to be syphilitic, is suffering from organic nervous disease, or from a functional disorder such as neurasthenia, or from one of the various types of manic-depressive disorders. The reaction also may be said to be stronger in syphilitic than in non-syphilitic organic disease.

Determination of Blood Alkalinity (Van Slyke)[5]

Blood is centrifuged and a few c.c. of plasma shaken into a flask containing 6 per cent. CO_2. Alveolar air is suitable for this purpose. The apparatus is meanwhile filled to the top of the graduated tube with mercury by raising the mercury reservoir *F*, care being taken that *D* and *E* are also filled. One c.c. of the CO_2-saturated plasma is then delivered into *A* and the stopcock *I* turned so that by cautiously lowering the level of the reservoir *F* the plasma runs into *B* (but no trace of air). The same procedure is repeated with 1 c.c. water, so as to wash in all the plasma, and finally 0.5 c.c. normal acid (approximately 5 per cent. H_2SO_4) is sucked in, after which stopcock *I* is turned off. The reservoir *F* is then lowered sufficiently to allow all of the mercury but none of the blood to run out of *B* and *C* (Fig. 65).

As the level of the mercury falls in *B* and *C*, the plasma effervesces violently, be-

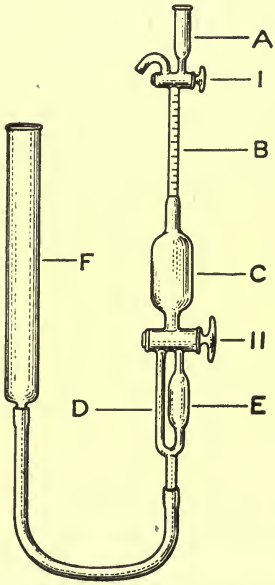


FIG. 65.—Van Slyke apparatus for acidity estimation

cause of the fact that it is now exposed to a vacuum. To be quite certain that all traces of CO_2 have been dislodged from the solution, the apparatus is shaken. To ascertain how much CO_2 has been liberated, stopcock *II* is now turned so as to bring *C* and *E* into communication, and by cautiously lowering the reservoir the fluid in *C* is allowed to run into the bulb *E*. Stopcock *II* is thereafter turned so as to connect *C* and *D*, and the reservoir raised so that the mercury runs into *C* as far as the CO_2, which has collected in the burette, will permit it to go. After bringing the level of the mercury in *F* to correspond to that in the burette, the graduation at which this stands is read. It gives the c.c. of CO_2 liberated from the plasma. Under the above conditions normal plasma binds 75 per cent. of its volume of CO_2; therefore, since the total capacity of the pipette is 50 c.c., the mercury should stand at 0.375 c.c. on the burette. In acidosis figures as low as 20 per cent. of the normal may be obtained, *i.e.*, 0.1 on the burette.

Finally to prevent confusion, it should be pointed out that a depression in the reserve alkalinity of the blood can also be determined by estimating the percentage of CO_2 in alveolar air.

Approximate Determination of Urinary Acidity.—The laboratory requirements are few and the procedure is not complicated. Prepare a N_{10} solution of sodium hydroxide and a 1 per cent. alcoholic solution of phenolphthalein.

Fill a 25 c.c. burette graduated in 0.1 c.c. and fitted with a stopcock with the sodium hydroxide solution. Measure exactly 10 c.c. of urine and place in a small porcelain dish or glass test tube together with two drops of the phenolphthalein solution as an indicator. Gradually drop into the urine, stirring frequently, the solution of NaOH from the burette, carefully noting the moment at which the mixture begins to show a pink coloration. At this point the amount of solution of sodium hydroxide used is read on the burette scale.

With urine of approximately normal degree of acidity, it will require about 3 c.c. or less of alkali solution to bring the urine to the point of appropriate neutrality. In excessive acidity, from 6 to 12 c.c. of hydroxide solution may be required.

The solution of sodium hydroxide is prepared by dissolving 4 grams of sodium hydrate in 1000 c.c. of distilled water. This yields a deci-normal condition; that is, one-tenth of a normal solution containing the equivalent of its molecular weight in grams; that is, 40 grams in 1000 c.c. of distilled water. To make the deci-normal solution, dissolve the sodium hydrate in about 900 c.c. of distilled water and reduce the solution to its proper strength by titration with a solution of oxalic acid. For this a deci-normal oxalic solution is prepared by dissolving 6.3 grams of chemically pure oxalic acid in 1000 c.c. of distilled water. Ten c.c. of the acid solution will be neutralized by 10 c.c. of the alkaline solution if the latter is of the proper strength. It will usually be found

that the alkali solution is stronger than a normal solution and will therefore require less than 10 c.c. to neutralize the acid. It will be necessary to add sufficient water to make up the difference; thus, if 8 c.c. are found to neutralize 10 c.c. of the acid solution, and if the initial volume was 900 c.c., it will require 223 c.c., that is, 2 c.c., of distilled water for every 8 c.c. used in the test. A second titration of the completed solution should be made to make sure that the dilution has been correctly made.

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PART II.

CHAPTER I

PSYCHOSES WITH SOMATIC DISEASE

REACTIONS DEPENDENT UPON FUNCTIONAL DISTURBANCES OF THE ORGANISM DUE TO INFECTION, STATES OF EXHAUSTION OR TOXÆMIA, AFFECTING THE SENSORY, MOTOR AND ASSOCIATING MECHANISMS, CHARACTERIZED BY DELIRIUM, CONFUSION AND PHYSICAL PROSTRATION

THE somatic disease group of psychoses includes a large number of acute mental disorders which are the accompaniments of states of general physical reduction which may be due primarily to infectious diseases and their toxins, or to states of physical exhaustion following the acute infectious diseases, or toxæmias resulting from disordered visceral functions. Again, states of exhaustion, which are the direct effects of excessive functional activity, with failure of the normal restorative processes, may furnish the exciting factor of the psychosis in individuals predisposed.

The first two groups of psychoses, on account of their clinical similarity, and also on account of the fact that it is often difficult, if not impossible, to separate them etiologically, are classed, for convenience of study, under the term **infective-exhaustive psychoses.** For example, in post-typhoid psychoses it is difficult to determine how much of the disordered nervous function is due to the direct effect of the infection, and how much to the state of exhaustion subsequent to the infectious process. Toxins, such as arise from infectious diseases involving non-nervous structures, doubtless produce secondary toxins by their effect upon metabolism. Such toxins, acting upon a nervous system predisposed and further reduced in resistance by long-continued exhaustive illness, may serve as exciting causes in the production of the class of psychoses to be considered in this chapter.

The infection psychoses, which are commonly spoken of as **deliria,** naturally fall under three headings: the prefebrile, the febrile and the postfebrile deliria.

In the deliria of infectious origin it is probable that several factors are concerned in the pathogenesis: (1) the rise of body temperature, usually regarded as the reaction to disease toxins on the part of the nervous system (thermogenic centres); (2) the direct action of the toxins upon the neuronic elements; and (3) the disturbance of the circulation in the cerebral vascular system. In view of such a complexity of etiologic factors, it follows that it is difficult and sometimes impossible to determine where one factor ends and another begins.

Prefebrile Psychoses (Delirium).—Occasionally in the prefebrile stage of the infectious diseases, the exanthemata, typhoid fever, pneumonia and influenza, there is an initial delirium which may readily be mistaken for a psychosis without infection, on account of the fact that the mental symptoms, which constitute a conspicuous part of the clinical picture, may obscure the symptoms of the concomitant physical disorder. Frequently it happens that the patient has been in a state of poor general health, as indicated by indefinite subjective prodromal symptoms, following which, more or less abruptly, there is noted some slight mental disturbance in the form of impairment of the power of concentration, insomnia and restlessness with mental depression. After a brief period of this mild mental aberration there frequently develops a marked delirium with periods of maniacal excitement of more or less sudden onset.

There is usually a profound involvement of the sensory sphere, giving rise to the misinterpretation of sensations and the production of distressing illusions. The sounds of people passing by on the street are disturbing to the patient and may be interpreted as threatening crowds. Additional false sensory stimuli give rise to hallucinations equally discomforting and productive of a state of mental terror. These sensory disturbances give rise to a marked degree of mental and physical unrest which adds to the already exhausted state of the patient. On account of the fact that the confused state of the patient's mind prevents him from understanding the motives of those in attendance, food is frequently refused, which fact further serves to endanger his physical state. The mental confusion gives rise to complete disorientation; the patient fails to recognize persons about him or his whereabouts, except perhaps for brief intervals during which he may seem comparatively clear.

From the physical standpoint, a pronounced delirium at the onset of an acute infection, *e.g.*, typhoid fever, is always regarded as of grave omen, indicating that the infection is of severe grade or that the resistance of the patient is feeble. During this phase of the disorder he may die from exhaustion. The delirium may also continue as a distinct psychosis extending beyond the fastigium of the disease and into and beyond the decline of the temperature curve.

In considering this class of mental disturbances it must be remembered that an infection may act as the exciting cause in the etiology of other mental disorders, as dementia præcox and manic-depressive psychosis.

Febrile Psychoses.—The febrile deliria may be said to be characterized by the fact that the prominence of mental symptoms is directly proportionate to the height of the temperature curve, and varies from a state resembling mild degrees of intoxication to that of paralysis and total collapse due to disintegration of the neuronic elements. The mental disorder develops during the fastigium of the febrile disease,

especially in typhoid fever, polyarthritis (rheumatic fever), pneumonia, influenza and the eruptive fevers. The particular physical disorder, however, has little influence upon the type of mental disturbance. This form of delirium differs chiefly from the prefebrile delirium in that the onset is less abrupt. The degree of mental disturbance varies greatly with the individual. Some persons require but a slight elevation of temperature to produce disconnected thought and rambling speech. Like alcohol, fever often serves as an index of the individual's nervous stability. There is practically always involvement of the sensory sphere, but the disturbance is less pronounced than in the prefebrile disorder. More commonly the tactile sense is involved, so that there are sensations which result in tactile illusions, and also in severer forms of delirium there is involvement of other senses, espe-

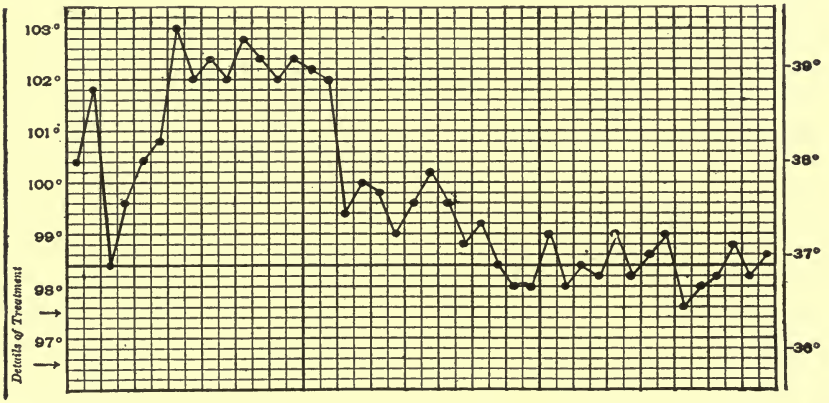

FIG. 66.—Chart showing temperature curve in a toxic, febrile psychosis with physical and mental recovery.

cially of hearing and vision. Consciousness is clouded only in the graver cases; this varies from a dream-like state to that of deep coma with carphologia and *subsultus tendinum or coma vigil.*

As long as the fever continues the mental disorder remains; commonly the delirium becomes more active with the rise in temperature curve, although such is not invariably the case (Fig. 66).

Motor involvement is present in the severer forms and may appear in the form of disturbance of the articulation, as in ordinary alcoholic intoxication, difficulty in swallowing, and twitching of the facial and other muscle groups, sometimes jerking of entire extremities. In instances in which the delirium is associated with marked psychomotor restlessness, the patient can be kept in bed with difficulty. In the momentary absence of a nurse, such a patient in an attempt to escape the imaginary impending danger, may rush through a window only to meet his death. The excitement usually makes its appearance in paroxysms, and often is dependent upon the vividness of the hallucinations and illusions. The emotional state of the patient is apt to change rapidly

from a mental condition characterized by calm pleasantry to that of exaltation, or even anxiety and terror or a state of frenzy. In grave cases, as the physical exhaustion increases, the excitement abates, and a state of coma may develop with a fatal termination.

The prognosis, like that in the prefebrile form, is grave, but somewhat less so than the latter. With the decline of the fever, the active mental symptoms may either disappear or may change in type to that of a delusional state. In the latter instances mental convalescence is tedious. In some cases the delirious state passes over into a subacute or chronic paranoidal condition. In such cases the prognosis as to mental recovery is not favorable. Usually the prognosis of the mental state depends upon the prognosis of the febrile disorder.

The Postfebrile Psychoses.—In this group of mental disorders the symptoms are strikingly like those of the febrile psychoses, but differ from the latter in the fact that the intensity of the delirium bears no relation to the height of the fever; in fact, the mental symptoms may be pronounced in the absence of fever. This class of deliria is regarded as toxic in origin. Mental disorders accompanying the infections are characterized by the constancy with which there is involvement of the sensorium, shown by more or less clouding of consciousness, stupor, confusion, hallucinations and illusions of the senses, together with motor restlessness dependent upon the severity of the sensory disturbances. This symptom-complex may vary from a state of slight mental sluggishness to one of violent delirium. By some authors the prefebrile disorders are included under the term "infection psychoses," and are found to occur early in typhoid fever and in the initial delirium of smallpox, septic infections, malaria, erysipelas, influenza, acute chorea with rheumatic arthritis and endocarditis.

A delirium of the initial type may continue after the temperature has fallen and thus clinically would pass over into the "postfebrile" group, from which no sharp line of demarcation can be made. Strictly speaking, the postfebrile disorder makes its first appearance after the disappearance of fever and is therefore practically an **exhaustion** psychosis. Some psychoses appear several weeks after the fall in temperature, when the patient is regarded as well on in convalescence from the infectious disease.

Exhaustion Psychoses.—As already pointed out in the general discussion of the etiology of mental disorders, exhaustion is to be regarded as the result of excessive functional activity of cells. This is dependent upon the inability of cellular structures to take up the necessary oxygen for the renewal of particular kinds of energy. In states of physiological fatigue, cells are able to resume normal functional activity after a period of rest, having received a new supply of the necessary chemical constituents. On the other hand, the end result of cell activity is the accumulation within its protoplasm of products of metabolism, of which the cell must rid itself, either in the form of

a secretion to be used in other bodily functions or as waste material. The accumulation of either class of substances within the cell prevents functional activity and also favors toxic accumulation. Here again is illustrated the overlapping of etiologic factors, for, in such instances, the resulting exhaustion may be regarded as toxic. For the purpose of clinical consideration it is convenient to differentiate exhaustion psychoses from those psychoses which are dependent upon the toxins of infections and other somatic diseases.

Exhaustion psychoses accompany those conditions which are productive of severe exhaustion states of whatever variety they may be. As in the postfebrile disorders, a tedious convalescence from an acute infectious disease, the loss of blood following injury or parturition, or in the physical strain of childbirth itself, prolonged mental strain, profound mental shock and, more rarely, severe fright in connection with other factors, are the usual exciting causes. In individuals with marked neuropathic tendency the resistance of the part of the nervous system to the exciting cause is correspondingly less, hence the exciting factor may be comparatively slight, and serve to indicate the degree of instability of the individual. Thus some women suffer from attacks of mental disorder with each pregnancy. On the other hand, the individual resistance may become raised as in a patient observed by the writer, who suffered a severe attack of mental disorder which came on during convalescence from typhoid fever, and from which attack complete recovery followed. More than a year later the patient passed through an uneventful gestation and delivery without any abnormal manifestations. This was, of course, made possible only by the fact that the nervous resistance had been raised sufficiently to bear the strain of the physical changes accompanying pregnancy.

Of the exhaustive psychoses group there are at least three divisions to be made: (1) collapse delirium, (2) acute confusion, and (3) states of acquired neurasthenia, or **secondary neurasthenia** (Chap. VII). These three forms of disorder vary in the acuteness of onset, the severity of mental symptoms and as to duration.

Collapse Delirium.—(Acute Delirium. Delirium Grave.)—This is the form of acute mental disorder referred to by the older medical writers under the name of phrenomania, typhomania, and Bell's mania. The onset is comparatively abrupt after a few days of "nervousness," restlessness and insomnia. The mental state quickly assumes a condition of confusion, due to disturbance in the sensory sphere and the result is a state of bewilderment. There is marked clouding of consciousness in consequence of which perceptions are not clearly received; the patient is no longer oriented, everything seems strange to him, and, in addition, the confusion is made greater by visual and auditory illusions. Persons appear strange to the patient and are misnamed; outlines of cracks in the plaster of the walls or ceiling are transformed into queer-shaped animals or faces; figures in the wall-paper assume

grotesque characteristics; ordinary sounds, such as persons talking, passing vehicles or even the tick of a clock, are all misinterpreted. Soon active hallucinations appear and the patient is apt to be greatly disturbed on account of the unpleasant character of the fantasms. Psychomotor activity is greatly increased, the patient becoming very restless, talkative with marked incoherence of speech content. Later, great excitement of a more marked degree than in any of the other acute disorders makes its appearance and the whole picture is dominated by an extreme degree of hyperactivity. Delusions, if present, are rapidly changed, are incoherent and depend for their content upon the character of the hallucinations, either of the exalted or the depressive type. In the state of excitement the patient is noisy, destructive, untidy, sometimes erotic and obscene in speech and conduct. It is impossible to hold the patient's attention on account of the rapid flight of ideas, and attempts to do anything for him are often met with resistance or by an attack upon those in attendance. This condition of affairs may continue until the clouding of consciousness becomes so marked that the condition is altered to the low, muttering delirium of the "typhoid state."

The physical signs and symptoms are many and in some instances take on serious and alarming characters. In the early phase of the disorder, insomnia is a persistent and troublesome symptom. Nausea and vomiting with distinct distaste for food are frequently met. The tongue is heavily coated, dry, and at times pain is complained of in the abdominal region. Very little food is taken as a rule; on this account there is great reduction in the state of nutrition with loss of flesh and physical weakness. Fever is commonly present, but develops with the mental disorder. In the grave stuporous phase of the malady the temperature may be subnormal, especially just before the termination in fatal cases. The general appearance of the patient is one which strongly suggests a profound toxæmia. The pulse at first may be quick, rapid and full, but soon loses much of its tension and becomes feeble and irregular, according to the degree of physical prostration. In extreme cases the extremities become cyanotic, with œdema and signs of general circulatory failure. Constipation is at times obstinate, the urine scanty, of high specific gravity, with diminished chlorides, and not infrequently there is a distinct albuminuria. Owing to the disordered digestive function and defective elimination, indicanuria is a more or less constant finding. The urine is distinctly toxic in many cases, which adds to the gravity of the condition. The skin is apt to be dry in the early phase with fever, but later becomes cold, clammy and leaky in the cases with marked prostration.

Acute Mental Confusion (Amentia), Acute Hallucinatory Confusion, Delirious Mania.—The line of demarcation differentiating acute confusional psychoses from the preceding forms lies chiefly in the point of the length of time required for the development, and in the length of the course of the attack which extends over a period

of several weeks—from six or eight weeks to several months in duration.

The same conditions favoring mental and physical exhaustion, which produce the more grave condition of collapse delirium, are active factors in acute confusion. Among those factors the strain of pregnancy and the puerperium and acute exhausting illness are the foremost physical causes, while excessive mental efforts combined with stress and worry are common contributing factors.

The disorder begins with a prodromal period in which the patient complains of disturbed sleep, unpleasant dreams, indefinite fears and anxiety combined with a feeling of confusion and numbness in the head. Difficulty in collecting the thoughts is a common complaint with defect in memory; the latter is apparently due to the fact that the power of attention is enfeebled. In the early phase of the disorder the patient may realize that his mind is not clear and may express the fear that he is "losing the mind." Within a few days more distinct sensory disturbances make their appearance in the form of hallucinations; at first these may be indefinite, such as flashes of light, indistinct voices, and other sounds which the patient often interprets as indicative of impending danger. Real sounds are commonly misinterpreted in terms of anxiety, fear and terror. The movements of other individuals about the house or ward are often interpreted as indications that they are coming to torture him; that some terrible punishment is in store for him. Later, there appear disconnected and varied delusions which are usually of a depressive and often of a horrible character. Relatives at home are in danger, or are suffering torture; the home has been demolished; the children are dead and their bodies have been left for the rats to devour; the patient believes that he is to be charged with "a thousand crimes." Cries for help, cursing and lewd conversations are heard, murders are being committed and bodies are piled up previous to being consumed. Occasionally the delusions are of an expansive type with a corresponding feeling of well-being. In such instances the patient may say that he is a prominent person, or is unusually possessed of wealth, power and accomplishment. Disordered digestion and a bad taste in the mouth commonly give rise to the idea that the food is contaminated or spoiled, or even poisoned. Disorientation is a frequent symptom, the room is changed, or the hospital is a house of ill-fame and its attachés devoted to crime and debauchery. The physician is an impostor, his treatment intended to do harm rather than benefit the patient. The patient often accuses those about him of giving him medicine that affects his mind.

The train of thought is marked by a rapid flow of ideas passing rapidly from one thought to another, often beginning a new idea before the last idea is completed. Notwithstanding the confusion of thought and the rapidity of flow of ideas, the dominant idea is apt to be one of fear of impending danger or of persecution.

The emotional state varies with the character of the sensory impressions and may express joy, sorrow, anger and indifference all within comparatively brief limits of time.

Motor activity is more or less constant, and although the patient is physically weak there is often a remarkable endurance and apparent insensibility to fatigue or bodily discomfort. There may be brief periods during which the patient is dull and inactive, with a tendency to sleep.

On account of the marked disturbance of the sensory sphere there are apt to be paræsthesias, hyperæsthesia or even neuritic pains. Insomnia is practically present in all instances and is persistent, except in the stuporous forms. The state of nutrition is reduced on account of the constant activity and insufficient food. The patient is too busily engaged to eat, or is often deterred from it on account of his delusive ideas. Fever is commonly not present; the pulse is slow and feeble; the respiration slow.

Choreic Psychoses.—Practically all patients suffering from chorea, of whatever form it may be, present a certain degree of mental disturbance. The present-day conception of the pathology of chorea prevents considering all forms of chorea in the same category, even from a mental standpoint.

Thus the acute chorea of Sydenham is regarded as the result of an infection, usually of a variety such as might continue in a centre or focus of infection, such as the tonsils, or teeth, upon which basis, from time to time, acute exacerbations may arise. In this sense the psychosis has the same etiologic origin as the chorea, as it is part of the same disease, and, therefore, strictly speaking, should be included with the infection psychoses.

The choreas which accompany pregnancy are likewise regarded as toxic, as are many of the true puerperal psychoses. Occasionally, as the writer has had the opportunity to observe, puerperal or gestational psychoses may be accompanied by marked choreic condition.

The mental disorder accompanying Huntington's chorea does not belong in the same category, having a more serious organic basis and an unknown etiology beyond inborn predisposition.

In the acute forms of chorea, which usually occurs in children and young adults, the disorder usually presents mental symptoms which give rise to an alteration of the patient's disposition. They appear mentally dull, are inattentive and indifferent; also irritable, peevish and even impulsive. Added to this there is psychomoter restlessness and to which are added the true choreiform movements which appear to exaggerate these movements. In children the true cause of the inattentiveness and restlessness is often overlooked, in consequence of which the patient is often punished for that which he is unable to avoid.

The defective power of attention not only prevents the accomplishment of mental or physical tasks, but interferes with impressibility

and thus involves the memory processes, hence little if anything is accomplished mentally.

The emotional sphere is usually seriously involved. Not only is there an excessive irritability, but the affective tone towards their intimates is altered and often diminished.

There may be moodiness with depression and weeping, or mild exaltation with laughter and mirth.

About the time that the disease has reached complete development, and the motor disturbances are pronounced, the mental disturbances may also become most marked.

Perception is imperfect and environmental facts are incompletely apprehended. Attentive power is enfeebled, so that the patient shows a marked distractibility, the slightest noise or movement serving to divert the attention. Emotionally there is usually a marked degree of irritability, the patient prefers not to be disturbed for any reason.

The train of thought shows an impoverishment; ideas are not completed, as the flow of thought appears to be interrupted due to feeble attention. For the same reason judgment is affected so that thought is seriously interfered with, and associated conclusions are lacking.

In the volitional sphere there is a characteristic inactivity, the patient's desires are few and the reactions lack spontaneity. The speech is also characteristically marked by motor incoördination of the mechanism, giving rise to a dysarthric speech; usually these patients talk but little; occasionally they are mute.

In the severe forms of chorea, the symptoms of intoxication are often pronounced. Hallucinations and illusions may be present, thus modifying the emotional reaction and judgment. Occasionally one meets with cases suffering from marked psychomotor activity in addition to the choreiform movements, so that it may be difficult to distinguish the two groups of movements. External stimuli in the severer forms serve to increase the motor agitation.

In still graver forms there develops a condition of stupor with delirium and a typhoid state which is of serious prognostic significance.

Pathology.—The morbid changes in the central nervous system in the infective-exhaustive group of psychoses as a rule are not striking macroscopically. The meninges are nearly always hyperæmic and may be the seat of punctate hemorrhages. When death has occurred slowly there may be a meningeal œdema with an accumulation of several centimetres of fluid. The cortical vessels are congested and appear bright red in the more acute cases; in the less acute cases, especially when there is accompanying vascular failure, the venous engagement is more marked than the arterial congestion. With the exception of engorgement, œdema, cellular infiltration and passive congestion of the membranes, there is little gross change.

The chief anatomical changes are microscopic and are usually clearly defined, although they may vary in intensity in different cases and in different localities in the same brain.

The principal changes are to be found as varying grades of disintegration in the cortical neurones and the cells of the nuclei in the basal ganglia and brain stem.

The cell changes are made prominent by the alteration in their staining qualities. The cell nuclei often stain more deeply than in the normal and in consequence can be seen conspicuously in the less deeply stained cell body. The nucleolus may have disappeared, but at all events is less prominent than in the normal cell.

In many instances the cell body is distorted, appearing swollen and rounded, or irregularly angular and shrunken in appearance instead of the usual pyramidal shape of the cells of the upper cortical strata.

The dentrites are smaller than normal or may have disappeared in some instances. The axis-cylinder likewise suffers, and the nerve fibres show degenerative changes when studied by the myelin sheath stains.

In extreme cases in which there is a general septicæmia, as occurred in a case in the writer's experience, there may be localized hemorrhagic extravasations into the substance of the gray and white matter, constituting an acute encephalitis (see frontispiece).

There are few, if any, changes in the glia cells, compared with the more chronic forms of inflammatory and degenerative changes. The nuclei of the neuroglia cells may be increased in size and may have begun to penetrate the cytoplasm of the nerve-cells (Tanzi).

Vascular changes other than the congestion already noted and consequent engorgement are not present. There may be swelling of the endothelium of the arterioles and proliferative changes may have begun. Usually the process is so acute as not to allow marked vascular degenerative changes to arise.

In the case here illustrated, which followed a severe erysipelatous infection, there were œdema, infiltration and congestion of the meninges. The vessels in the interior of the cerebellar substance were widely distended with blood and in many places hemorrhagic extravasations occurred in which were numerous polynuclear leucocytes.

Treatment of the Toxic-exhaustive Psychoses.—In observing the clinical picture presented by the average patient suffering from the severer types of the exhaustive psychoses, one is impressed with the utter failure on the part of the organism to cope with environmental conditions. In fact, the point has been reached at which the organism cannot cope with itself; it cannot digest food properly, metabolic processes are disordered so that waste products are not eliminated at sufficient rate, hence these accumulate at a rapid rate.

On a neuropathic foundation, with or without physical disease, a state of lowered resistance is developed as a result of long-continued emotional stress the accompaniment of excessive mental effort, anxiety or worry, loss of sleep, insufficient food or an exhausting illness or infection. Invasion by infectious organisms may thus be made more facile and the patient's recuperative power becomes progressively less as

the result of the loss of balance between wear and repair. The result is a more or less sudden halt in the equalizing control of the nervous mechanism over the vascular, secretory and muscular systems constituting the physiologic components of the "emotive apparatus." These disturbances and the accompanying disorders of the psychological processes give rise to the psychotic disturbance as complicating factors. In the effort to gain "dominance over environment" the conflict has become psychic as well as physical.

The treatment of the toxic-exhaustive psychoses should be directed towards the fulfilment of the indications, namely, (1) to secure the conservation of the physical functions; (2) the elimination of accumulated toxins as promptly as possible consistent with safety to the bodily functions; (3) securing rest for the exhausted nervous system; (4) the maintenance of an adequate food supply during the restoration process; (5) the treatment of the convalescence or period of reconstruction—the physical and mental readjustment.

On account of the fact that the patient needing treatment most is usually the one whose mental state is such as to preclude the possibility of his coöperation, the problem is made difficult. Commonly the patient is in a state of marked mental confusion, he is reacting to vivid hallucinations and illusions of the senses and is restless, sleepless and physically exhausted. On account of his mental confusion and consequent inability to understand the motives of those about him, all attention on the part of the nurse is resisted and often violently opposed. On this account food and drink are rejected, each mouthful being spit out as quickly as it is given; bathing is made difficult; sleep is absent; in short, everything favorable for the administration of measures calculated to aid recovery is absent.

In the first place a nurse who is capable of meeting these situations is indispensable. For a time two nurses may be required on account of the necessity of constant attention and of the need of more than one person for the management of the patient in carrying out the details of treatment.

The patient should be carefully examined from the standpoint of the general physical state with the view of determining if possible the nature of the causative agent.

On account of the patient's inability to coöperate, it often happens that only a cursory examination of mouth, nose and throat, ears, heart, lungs, glandular system, abdominal organs, genitalia, etc., can be made. The temperature is best taken by rectum to make sure of the registration; and in no case should this be omitted, if possible, four hourly for a day or two at least. Any focus of infection which may be found, such as otitis media, tonsillar or dental focus, should not be passed without receiving careful attention as the circumstances and the degree of coöperation of the patient will permit. The patient may be so ill that it may be necessary to at once direct all effort towards raising the

resistance of the patient to a point at which the elimination of toxic products exceeds the rate of production, and to wait until general improvement becomes such that necessary attention can be given to any definite focus which might exist. It is with the patient of this type in mind that the present mode of treatment is outlined.

The blood should be examined as promptly as possible and with particular reference to the differential leucocyte count, for excluding or obtaining corroborative evidence of infection, looking with grave suspicion upon a total of fifteen thousand cells or over per cubic millimetre.

The blood should also be examined with the object of determining the presence of a state of "acidosis," which is interpreted in terms of diminished alkalinity of the blood plasma, as can be readily determined by the Van Slyke method for the detection of CO_2 in fluids (see Laboratory Methods, p. 209, *et seq.*).

It is shown that the resistance of the body cells depends largely upon the alkalinity (bicarbonate content) of the blood plasma, which is constantly being drawn upon in health and to a greater degree in toxic states, on account of increased acid production by the tissues as a result of increased metabolic activity and the production of carbon dioxide, phosphoric, lactic and sulphuric acids. Under such conditions the alkali supplied to the blood plasma must be produced at a greater rate in order to meet the excess acid production. If this cannot be met, the patient succumbs to an "acidosis" toxæmia, for a sustained increased acidity is incompatible with life; this in turn, on account of the loss of the isotonicity of the blood plasma, causes hæmolysis of the red blood cells, thus establishing a vicious circle.

After an initial examination of the blood plasma has been made from the alkalinity standpoint, a satisfactory but only approximate check can be made daily by the determination of the degree of acidity of the urine by the method commonly used for titration of normal solutions (see Laboratory Methods).

In the majority of cases presenting the toxic-exhaustive syndrome, the acidity is excessive. The clinical picture may strongly resemble the "typhoid state." In such cases the treatment is directed to the "acidosis," the supplying of the food in liberal amounts in proportion to the ability of the digestive apparatus and to the stimulation of the circulatory apparatus.

Liquid diet given in moderate amounts in two- or three-hourly feeding is advantageous on account of the ease with which it is administered, compared with semi-solid or solid foods, its value in minimizing the burden of the alimentary organs, and also on account of the beneficial effect of the water content of the average liquid food.

Bathing the entire body at least once daily is almost imperative because of the value of the procedure in increasing skin elimination. If the strength of the patient will permit, the continuous warm bath for

one-half to one hour daily will often serve to sedate the patient and at the same time favor elimination. Wet packs, not cold, may be used to advantage for the same purpose as the prolonged bath.

Sedative drugs are to be used only as a last resort in the early phase on account of their ill effect as depressants of the circulation, their interference with secretory functions and their tendency to check elimination.

With the view of neutralizing acidity, that is, of raising the alkali reserve of the blood plasma, the administration of alkalies, both by mouth and by bowel, is often well employed. In the form of the salts of potassium, citrate and acetate, in dosage of five grains every two to four hours in a liberal quantity of water, these substances are important to fulfil the demands of the body cells for the potassium compounds.

The chlorides are best supplied by normal physiologic salt solution 0.6 to 0.85 per cent. solution by bowel, by the Murphy drip method, alternating with 1 per cent. sodium bicarbonate solution; in severe toxæmic conditions these may be administered without interruption day and night for several days.

In cases of extreme toxicity characterized by stuporous states or coma, direct intravenous injections of 300 to 500 cubic centimetres of physiologic salt solution may be administered.

In threatened circulatory failure the digitalis group of drugs are important aids. The freshly prepared infusion of digitalis, on account of its diuretic effect, is preferable. In urgent need of cardiac stimulation Digalen in doses of 5 to 8 minims may be given hypodermically, or by mouth dropped under the tongue, or adrenalin may be advantageously administered.

Other medication is not called for as a rule, unless complications arise.

Food and water are of prime importance. If the patient rejects food, forced feeding with stomach or nasal tube may become imperative to save the patient's life. Such patients cannot afford to go long without food. The same is true of the need for water. If necessary the dropping of water into the mouth from a medicine dropper at frequent intervals day and night will in a few hours amount to many ounces of fluid ingested.

The raising of the blood pressure by the intravenous and intestinal routes aids in the diuretic effect and the elimination of toxins.

The question of the use of sedatives and hypnotics is a difficult one which must be solved according to the merits of the factors concerned in every case as an individual. In instances in which there is imminent danger from exhaustion as the result of excessive psychomotor activity something must be done to obtain rest for the patient. In extreme cases a single dose of cerebral sedative such as hyoscine, gr. 1/100, may be advantageously employed in order that a patient can be put in a pack, though with skilled nurses

the former is rarely necessary. Morphia is on general principles contraindicated. The safest hypnotic is paraldehyde, which may be given in doses of from one-half to four fluid drachms as indicated. After the patient has reached the road to convalescence and when the tepid bath followed by the alcohol rub is not sufficiently soporific, small doses of veronal or trional may be administered, five grains of the former or ten of the later, given with a glass of milk.

In favorable cases, as the mental clouding fades and the hallucinatory reactions disappear, the patient begins to show signs of interest in himself and his recent experiences, of which he may have no recollection or only a vague memory. At this point he realizes a sense of profound exhaustion and sooner or later presents the typical picture of one recovering from an exhausting illness, such as lobar pneumonia. It is now that careful feeding and nursing, both from a physical and mental standpoint, are demanded. The attitude of physician and nurse should be encouraging and such as to inspire confidence in the patient concerning the hopefulness of the outcome of the attack. If conditions are favorable, he should be gotten as near to the open as possible before he is permitted to get out of bed. Some form of mental diversion should be instituted as soon as it can be done without danger of mental fatigue. Much depends upon the resourcefulness of the nurse in this direction and her ability to detect signs of fatigue, usually indicated by the patient's restlessness and inattentiveness.

As the patient shows signs of progressive gain he should be allowed to sit up a short time each day, gradually increasing the time each day until a few hours are allowed. The diet also should be carefully increased to the full normal amount, properly proportioning the essential classes of foodstuffs in easily digestible form.

Exercise should be guardedly begun and its effect upon the circulation and the nervous condition noted. Passive exercise in the form of massage and mild passive movements in bed are best at first. Later, short walks as strength is gained may be allowed.

When the patient has reached the point of sitting up for a few hours at a time, some light manual occupation is of value on account of the beneficial mental effect.

Basket-making and weaving with a small portable hand-loom make not only interesting diversions but also are therapeutically advantageous occupations for the convalescent and usually constitute part of the equipment of most of the mental hospitals and better class of sanitaria.

Psychoses with Visceral Disease.—In this group of disorders are included the disorders associated with somatic or visceral disease and accompanying toxic states, such as are met in diabetes, gout, uræmia and the disorders of the ductless glands. In all probability their etiological importance lies in the predisposing neuropathic constitution of the patient in most instances. For example, a patient, sixty years of age, who suffered an attack of depression in early life, learning that

she had become diabetic immediately developed a typical agitated depression, such as occurs frequently in middle life without demonstrable visceral disease.

In other cases, when the diabetic condition has existed for some time, there may appear, as the result of the toxæmic mental dulness, depression, retardation of thought, or distinct mental enfeeblement. Some patients show signs of mental confusion, ideas of negation, unworthiness and suicidal tendency, as observed by the writer in a patient who suffered from diabetes mellitus for twelve years before the appearance of the symptoms of agitated depression.

The consideration of the diabetic comas scarcely has a place in these pages except to note that occasionally one meets with premonitory mental symptoms of depression, excitement or confusion followed in a few days by a state of stupor. This may take place in diabetics when the sugar output and the amount of urine excreted have rather abruptly fallen. In such cases the outlook is unfavorable; death usually occurs in a few days. In some instances the patient recovers from the first attack, but sooner or later suffers a recurrence.

Diabetes is not infrequently seen in patients suffering from psychoses of long duration, as in the depressions, dementia præcox and in mental defectives. In such instances the diabetes cannot be said to be causally related to the mental condition.

A patient, an imbecile, observed by the writer for a number of years, who passed through several attacks of excitement and depression, had an intermittent glycosuria, which could not be shown to have any direct relation, in point of the time of its appearance, to the occurrence of the mental episodes.

Uræmia.—While essentially toxic in an etiologic sense, the psychoses which accompany uræmic states are of such frequency as to warrant their discussion under the visceral disease group.

Clinically, the mental disorders associated with uræmia are essentially deliria, characterized by clouding of consciousness, confusion or stupor. The uræmic state, as has been already stated, may be a contributory factor in the pathogenesis of delirium tremens.

De Fursac[1] distinguishes two forms of uræmic delirium: an expansive and a depressed form, depending upon the attitude and reactions of the patient and the delusional content. In the expansive form the patient exhibits euphoria and grandiose delusions, yet with a marked degree of clouding of consciousness and disorientation, more or less complete.

The depressed types are characterized by painful reactions brought about by unpleasant or terrifying hallucinations which may involve several of the senses, especially visual, auditory and olfactory. Depressive delusions of a persecutory character are based upon the sense falsification. The delirium may appear in the form of acute exacerbations, which seem to arise out of a state of stupor into which the patient

may relapse from time to time. Thus a man, seventy years of age, who had suffered from chronic diarrhœa of about a year's duration, abruptly developed mental symptoms marked by unusual ideas of self-importance and delusions of persecution; at times he was violent, talked almost incessantly and threatened to kill himself. Periods of transitory delirium or of great psychomotor activity with ideas of superiority alternated with periods of stupor. The stuporous periods gradually lengthened, until finally a state of coma developed; the temperature rose to 105° shortly before the fatal termination.

The patient may emerge from the delirious state and enter a condition of more or less mental clearness, but with a residual paranoid condition with systematized persecutory delusions.

Diagnosis.—On account of the frequency of the association of uræmia and alcoholism, the diagnosis may for a time present some difficulty. The physical signs and laboratory findings must be depended upon in such instances. Urinary suppression, albuminuria and the other findings of nephritis, together with myocardial and arterial changes, œdema of the face and extremities, anæmia, dyspnœa and compensatory diarrhœa, are suggestive of the nephritic origin of the nervous symptoms.

Disturbances of the Endocrine Glands.—The study of disorders of the glands of internal secretion has in the past few years been receiving much attention. As stated in a preceding chapter, the physiology of the endocrine organs from the standpoint of its relation to the emotions has been extensively studied by Cannon and Rogoff and others, and in connection with the disturbances of the autonomic nervous system.

As noted in the chapter on etiology, defects of development are known to accompany dysfunction and hyperfunction of the pituitary and pineal glands, but as yet no definite data have been collected in regard to disturbances of mental function in individuals of more or less normal development.

In the matter of the thyroid gland, on the contrary, there are to be differentiated mental disorders due to insufficiency of the thyroid and psychoses accompanying hyperthyroidism—sometimes termed **thyroigenous psychoses.** These are the myxœdematous psychoses and cretinism and the mental disturbances accompanying exophthalmic goitre.

Myxœdematous Psychoses.—The mental disturbances accompanying thyroid insufficiency may be the result of developmental defect, or of atrophy from disease or as the result of deprivation by surgical means. The physical signs of thyroid insufficiency are quite characteristic. The skin is rough, dry and appears thickened as the result of an increase in the connective tissue of the deep layers.

The lips also are thick, and in marked cases the tongue seems too large and interferes with speech. The facies give the appearance of the tissues of the face being puffed or swollen. The hair is dry and harsh and sometimes falls out. The hands and feet especially appear irregularly swollen and are misshapen.

The body temperature is commonly subnormal, and metabolic processes are sluggish. Carbohydrate tolerance is said to be increased, so that the patient can ingest larger quantities of sugar than in the normal without giving rise to glycosuria. The circulation is sluggish; the pulse slowed to 50–60 beats per minute. The voice is commonly changed, becoming altered in pitch and harsh. The mental symptoms are usually marked by dulness, slowness of the train of thought, or a state of stupor may develop. The mental sluggishness is often first noted when the patient's activities in the daily duties become lessened.

The patient seems to tire easily, and requires a much longer time to accomplish very simple acts as in dressing and eating. There is a loss of interest in the surroundings; thoughts are collected slowly, although usually there is no actual clouding of consciousness. Sometimes the patient is overtaken with somnolence which may become profound and pass into a state of lethargy.

As occurred in a patient observed by the writer, there may be attacks of confusion, with distressing hallucinations and consequent excitement which are followed by a state of stupor. In this case there were premonitory symptoms lasting several weeks, in which there were persecutory delusive ideas; this was followed by an attack of violent excitement, which terminated in a state of stupor lasting several weeks.

There is usually distinct memory defect especially for recent experiences.

Emotionally the patient is usually indifferent, although irritability is apt to be present when the patient is pressed into activity. Sometimes there is a more or less uniform state of depression with anxiety, but usually without definite delusion formation.

Treatment.—Unless the condition is recognized early enough for the administration of suitable therapeutic measures the disorder progresses and terminates in a state of mental enfeeblement with increasing sluggishness of the bodily functions and terminates in death from exhaustion or intercurrent disease. If, however, the administration of a thyroid gland preparation is given in gradually increasing doses, the improvement both mental and physical is often striking in a comparatively short time.

Usually the dose should be small at first, beginning with one-half to one and a half grains of the dried gland three times daily. While the patient is taking thyroid frequent observation should be made on account of the danger of toxic effects of the remedy, shown by headache, dizziness, irregular heart and tachycardia. When these symptoms appear it is well to stop the remedy for a day or two and resume with a smaller dose or a more gradual increase. As a rule, improvement will be noted within a week or two. The mental dulness gradually lessens; the patient becomes more active and in better spirits and the mental state in general becomes improved.

Physical improvement likewise is manifested by the better color

of the skin, loss of the puffy appearance and a reduction in the body weight. In the course of a few months the degree of improvement is very marked. The patient should be carefully watched and an occasional course of thyroid medication should be given to avoid relapse, which is not infrequent in patients who neglect treatment.

Hyperthyroidism (Exophthalmic Goitre, Graves's Disease).—Mental symptoms are very commonly associated with hyperfunction of the thyroid gland, which doubtless exists in many persons who do not present the usual physical signs and symptoms of hyperthyroidism.

Etiology.—Excessive activity of the gland seems to be the exciting cause, although the pathogenesis of the disorder is not understood.

In some instances the symptoms of hyperthyroidism have been found to subside after the removal of a source of infection, thus suggesting the infectious origin of the glandular affection.

The most pronounced symptoms occur in connection with exophthalmic goitre. Just as the physical signs of hyperthyroidism are different from those of thyroid insufficiency, so do we find that instead of the reduction in mental activity as in myxœdema the mental symptoms in hyperthyroidism approach those of delirium.

It is very clear that in Graves's disease the nervous system is implicated to a serious extent. There is much evidence to show that the disease occurs in individuals who seem to be predisposed in that they are the possessors of inherently unstable nervous systems. Exophthalmic goitre and nervous diseases, including psychoses, occur frequently in different members of the same family. An exophthalmic woman is recorded as having a daughter a cretinic idiot. F. H. Packard analyzed a series of eighty-two cases of Graves's disease with mental disorder, with physical signs "tolerably well marked"; twenty of the patients were men and sixty-two were women. He found a neuropathic heredity marked in 63 per cent. There is an heredity chart [2] on record showing a pedigree in which three sons and five daughters and three grandchildren were subjects of exophthalmic goitre. In 6 per cent. there was a definite heredity for Graves's disease.

Of the whole number, 15 per cent. had suffered attacks of mental disorder before the thyroid disease was noticed, so that the psychoses might have developed without the goitre.

Symptoms.—The symptoms of hyperthyroidism as seen in exophthalmic goitre present the antithesis of the syndrome associated with absence of the thyroid. They correspond rather with the symptoms attending the administration of thyroid gland in full doses. In hyperthyroidism there is rapid action of the heart, the skin is thin and apt to be moist, and there are signs of increased nervous activity in the form of tremors, excitability and mental irritability. According to Magnus Levy, the respiratory exchange of gases is increased by 50 per cent. Sugar toleration is diminished so that glycosuria may occur. Sufferers from chilblains and ordinary colds are said to become immune when

they become hyperthyroid, and tuberculosis, it is stated, rarely occurs in uncomplicated cases of Graves's disease.[3]

By far the majority of patients suffering from hyperthyroidism present mental symptoms in some degree. In fact, mental symptoms may be the earliest noted, that is, before the cardiac or ocular symptoms become manifest. The most commonly noted are an intense and indefinite agitation with more or less mental and motor restlessness. The patient is unable to settle down to any occupation, and complains of being distressed by any sudden noise or unexpected news, this being accompanied by a palpitation that may last several hours. Other patients suffer with marked excitement, restlessness, sleeplessness, hallucinations, incoherence, violence, refusal of food, dirty habits, emaciation, diarrhœa and exhaustion which may terminate fatally.

Savage, in Guy's Hospital Reports, reported several cases of psychoses with Graves's disease, with the conclusion that when associated with exophthalmic goitre the prognosis as to life is very grave. Three of his cases were of a severe type; two cases terminated fatally. With marked and distressing palpitation the patients later became dull and sleepy and died of exhaustion. Another case began with mental depression, followed by maniacal state. Some instances of recurrent psychoses are mentioned in which the mental symptoms and the goitre appeared and disappeared simultaneously.

Dr. George Murray reported that out of 180 patients three developed psychoses, while ten others had hallucinations without other evidence of mental disorder. It should be mentioned here that mental symptoms, especially hallucinations, can be produced by the administration of thyroid extract to persons who are susceptible. No one type of mental disorder can be said to be characteristic of hyperthyroidism, but in the cases of severe grade, agitated depression and confusion with hallucinations seem to be more frequent. One case reported by J. P. Grieves was of a severe form of mania, which terminated fatally after six days of pyrexia. Three days before death the gland was so reduced in size that it could not be palpated.[4] Four cases are reported by R. H. Steen,[5] three making good mental recoveries, one after two years' duration, and all with a subsidence of the goitre symptoms. One patient died within a week after admission. Of the recovered cases, it is said that improvement was decided after the administration of adrenal extract. Gilmour[6] gives an optimistic report of seven patients, four of whom recovered. He found a neuropathic history in most of the cases.

It is evident that there are many features connected with the malady under discussion which point to a very close relationship of the nervous system, as most of the symptoms implicate the nervous mechanism. The question still to be answered is whether the disease is primarily one of the thyroid gland or of the nervous system. If the gland is the primary seat of the disorder, the nervous system suffers chiefly in the reaction. If the disorder is fundamentally one of the nervous system,

the thyroid is apparently affected through its blood supply, which has been altered by reason of a disturbance of the vasomotor apparatus. No matter which may be the original seat of disturbance, there is doubtless established a vicious circle. The excessive secretion affects the nervous mechanism controlling the circulation in the organ, which, in turn, intensifies the state of hypersecretion.

There seems to be little doubt that certain individuals are, by reason of inborn characteristics, peculiarly susceptible to the effect of thyroid secretion. In fact, Kocher [7] has shown that iodine applied to the skin will, in certain persons, produce a condition which closely resembles Graves's disease without producing the usual signs of acute iodism. Whether this is an accident or coincidence, there does seem to be an hyperthyroid potentiality, which is present in certain individuals, coupled with a peculiar nervous instability, and this combination of predisposing factors is what presumably is needed for the establishment of the syndrome seen in hyperthyroidism. There are, doubtless, many individuals in whom the activity of the thyroid gland varies considerably at different times, just as under varying conditions any other epithelial organ may vary in activity. All of these persons do not present the usual symptoms of hyperthyroidism, for the reason that they are not sensitively reactive to the secretion of the gland.

Until more knowledge is obtained in regard to the action of thyroid upon persons who have neither hypothyroidism nor hyperthyroidism the pathological physiology will be still a matter of speculation.[9]

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CHAPTER II

TOXIC PSYCHOSES

REACTIONS PRODUCED BY THE ACTION OF NOXIOUS MATERIALS OF EXOGENOUS ORIGIN, AFFECTING THE NERVOUS SYSTEM MORE OR LESS DIRECTLY, AND CHARACTERIZED BY DELIRIUM, CONFUSION, PARANOID REACTIONS OR STATES OF MENTAL ENFEEBLEMENT

THE intoxications follow the introduction from without, or the development within the body, of organic or inorganic toxins which affect the neuronic elements so as to interfere with their function or alter their structure. These psychoses may assume the characteristics of mental exaltation or depression; they may give rise to persecutory delusive trends, or to a state of confusion, of stupor or amnesia; they may finally terminate in a condition of dementia.

On account of the clinical variations which the intoxications may present, the etiologic criterion cannot be considered adequate. The term as employed does not indicate a definite reaction type, but rather a group of reaction types, hence it constitutes an etiologic rather than a clinical class of psychoses. On this basis two large groups with their subdivisions have been recognized:

1. **The exogenous intoxications,** arising from alcohol, opium (morphin), cocain, lead, mercury, chloral, atropin, chloroform, santonin, carbon monoxide and some other chemicals employed in industrial occupations.

2. **The endogenous intoxications,** which arise from disordered glandular activity, including the excretory organs, the digestive secretory system, and the endocrine functions (Chap. I, Pt. II).

Any of these poisons may find a predisposed soil, either inherited or acquired, but in some instances may be considered as acting upon a nervous system which normally evolved from the standpoint of mental defect. The importance of this consideration is illustrated by the fact that mental defectives of the imbecile class are particularly susceptible to the action of certain poisons, especially to alcohol.

The toxic psychoses are apparently without primary organic foundation, but it must not be overlooked that organic brain disease may eventuate in the terminal state of a toxic condition. In such instances the symptoms of organic disease and the corresponding neuronic destructive processes arise as remote effects of the long-continued action of the poison upon non-neuronic structures, rather than as a result of the direct action of the toxic substances upon the structural elements of the nervous system. This is particularly the case in the terminal dementia of chronic alcoholism.

The Exogenous Intoxications.—In considering this division of the toxic group of psychoses, according to the above conception of the subject, only those disorders which arise as the result of extraneous substances taken into the body will be included in the subgroup under the head of the **toxic psychoses.**

Alcohol.—The first in order of importance are the alcoholic psychoses, so called because the mental disorder has as its chief etiological factor the habitual and excessive use of alcohol.

Alcoholic psychoses beginning acutely may take on any form varying from mania to the deepest stupor. Some cases fall a little short of delirium and are accordingly known as hallucinatory forms of alcoholic psychoses. One group of cases constitutes a class which usually terminates in recovery from the acute symptoms, but in which persistent delusions remain and a moderate degree of dementia develops. Upon this basis has been recognized an alcoholic hallucinatory dementia. Another group is characterized by attacks which follow a more or less protracted course, with the predominance of delusions of jealousy and with a close resemblance to paranoia. Still other types are symptomatically known as polyneuritic and amnesic varieties.

Etiology.—In the first place, the question arises, Why do some individuals, who for the greater part of their lives have appeared normal in most respects and who have been successful business men, well educated and often mentally unusual, become changed as to habits to the extent that they habitually drink alcohol to the point of temporary or permanent mental disorder, exclusive of drunkenness?

This seems to be at least partly answered by the results of the observations made by F. W. Mott,[1] who studied the results of clinical and post-mortem examinations of patients dying in the Charing Cross Hospital and Claybury Asylum. Mott found, among the alcoholics with psychoses, that the percentages of instances of cirrhosis of the liver was much smaller than in alcoholics not mentally affected. (It has long been recognized that the "hobnail liver" is not common in patients dying after alcoholic psychoses.) The deduction made by Mott is that persons who suffer mental derangement from excessive use of alcohol become mentally affected before they have opportunity to take sufficient alcohol to cause hobnail liver. For the same reason, it is believed that a person who is able to drink sufficient alcohol to produce liver cirrhosis, and yet does not suffer from nervous or mental symptoms, is the possessor of an inherently stable nervous system. Still more recently the same author's synopsis of autopsies to the number of 1099, in which alcohol was the direct cause of the disease for which the patients were admitted to the hospital, there were 85 patients. or 7.7 per cent., with cirrhotic livers, in males 9.1 per cent. and in females 4.9 per cent. In 1271 autopsies at Claybury Asylum there were but 23, or 1.8 per cent., of cases with hepatic cirrhosis.

We know that there are some persons who are particularly suscept-

ible to the action of alcohol and are therefore less resistant. In such individuals an amount of alcohol, which might not produce visible effects in persons of more stable nervous make-up, may produce serious disturbance of nervous function in the neurotic. Persons in ill-health frequently find temporary relief from nervousness by taking medicinal preparations containing large percentages of alcohol. By such means a state is readily acquired on the part of the nervous system which demands more or less constant stimulation. Among the uneducated pure ignorance of the danger attending the habitual use of large quantities of alcohol and the force of example of those who appear to be able to take alcohol with impunity are undoubtedly to be regarded as causal factors in the establishment of the drink habit. Many excessive drinkers are in the habit of taking very little food while they are drinking to the state of intoxication. On this account there is formed a vicious circle; the physical state reduced through lack of food calls for continued stimulation, and ultimately the point is reached at which there is a maximum amount of saturation with alcohol and a minimum amount of available foodstuff, with the result that the nervous system is not only deprived of nutriment but is overburdened by an excess of toxic material and at the same time the bodily resistance is progressively lessened.

Persons who are in the habit of drinking "for the effect of the stimulation" admit that, as long as they are feeling physically in good health and are free from worry, they are free from the desire for stimulants. If, however, they become "let down" from any cause whatever, they soon experience a feeling of restlessness, general nervousness, usually with insomnia, and the sensation of a lack of something which can only be supplied by alcohol. With the knowledge of the fact that the condition of general discomfort from which they suffer can promptly be removed by the ingestion of an amount of alcohol, the inebriate is usually not long in finding that which will give him relief.

Furthermore, such individuals are rarely if ever satisfied with the initial quieting dose of alcohol, but are immediately possessed of the desire for continued stimulation. On account of this peculiar reaction to alcohol, they continue to drink until they reach a state of profound intoxication, or on account of gastric irritability they are unable to retain more alcohol.

Examples of extreme morbid craving for alcohol are found in the form of **dipsomania.** These sufferers are able to get along without alcoholic stimulation for a time, during which period they may even possess a real distaste for alcohol; but, sooner or later, there arises an irresistible impulse to which the dipsomaniac succumbs, often with a degree of periodicity so clearly defined that the attack can often be foretold by those acquainted with the individual. Such attacks are regarded in some instances as nervous manifestations equivalent to psychic epilepsy and migraine.[2] The attacks are sometimes dreaded by

the subjects themselves, so that rather than suffer they may either threaten, or actually accomplish, self-destruction by suicide.

Some individuals of neurotic disposition drink in moderation for many years and later, under severe physical or mental stress, find, perhaps accidentally, that alcohol will temporarily relieve the physical and mental discomfort. They thus find it an easily obtainable solace to which they readily succumb.

An example which came under the writer's notice occurred in a man who for many years drank in moderation. Under stress of circumstances on a given occasion, he drank to a state of intoxication. Following this he became totally disgusted with himself and ashamed that he should thus lose his self-control, on which account he thereafter invariably declined to drink in company in order to show that he possessed his desired self-control in that direction. On leaving the company of friends, however, he would be seized with regret that he did not accept the invitation to drink and with a desire for alcohol which he usually satisfied promptly in secret. The fact that he drank in secret would then disturb his conscience, causing such intense remorse because of his wrong that more alcohol was necessary to drown the anguish, and with the result that more and more alcohol was usually taken until a state of intoxication was reached.

Alcohol and Head Traumatism.—The relationship, from an etiological standpoint, which exists between head injury and alcoholism is an important one. The majority of instances of psychoses following head injury occurs in alcoholics. It is not infrequent to note that persons who were able to consume large quantities of alcohol before the injury, lose that tolerance after head traumatism. It then appears that in these instances comparatively small amounts of alcohol may give rise to mental disturbance.

Persons who have been regular drinkers for years and able to take large amounts of alcohol without becoming intoxicated, lose their tolerance after head injury, which may be followed by a psychosis of several months' duration.

The origin of the instability of the alcoholic is the next question to be answered. Clearly, it is either inherited or acquired. That is, there has been transmitted from parent to child a neuropotential instability, a state of feeble resistance on the part of the nervous system. This turns us again to the statement that the neurotic individual is abnormally sensitive to alcohol and, further, often shows a marked tendency towards the abuse of it. In the case of the head injury, the lessened resistance is acquired.

Frequently we see this exemplified when comparing the resistance of individuals drinking like quantities of alcohol, some showing nervous symptoms and others none. Some persons, after many years of drinking, show symptoms of disease in other viscera. Still another group, of a neurotic disposition, are subject to acute attacks of alco-

holism, which terminate as chronic alcoholic disease of the nervous system, but without the development of psychoses. *"Pour devenir alcoolique il faut être alcoolisable."* [3]

It has been said that "alcohol is the touchstone of the equilibrium of the cerebral functions." This statement is probably not intended to include the natural predisposition of the young and those who have never taken alcohol.

Again the susceptibility to the effects of alcohol may be increased by weakness and disease.

Many attacks of acute alcoholism will predispose to and often terminate as attacks of true psychoses.

At first sight alcohol may sometimes be regarded as the cause of a psychosis when really the excessive indulgence is an early symptom. Not infrequently do patients seek rest and comfort from the mental pain and excitement of the early phase of a psychosis by resorting to the use of alcohol, as in neurasthenic and depressed states. Here alcohol is a coexciting cause. In the beginning of a manic attack and in paresis, the excessive indulgence may be the result of loss of control of the appetite, thus constituting a symptom of the psychosis.

Alcoholism may be the predisposing cause, or it may be a symptom, of mental disorder. It may act as a direct poison by interfering with the nutrition of the nervous elements; it may be a concomitant cause with heredity, or with a physical disease, such as tuberculosis, syphilis, Bright's disease, trauma and sunstroke.

Why alcohol in some instances produces in one individual, predisposed, a multiple neuritis and in another an hallucinosis is yet to be explained.

As has already been mentioned, idiots and imbeciles are notably susceptible to alcohol; also we may add neurasthenics, epileptics and the neurotic; according to Mott, "the failure to discriminate between what is heredity and what is the result of alcoholism has been the cause of much confusion," and the failure to place alcohol in its proper position with regard to its importance in the causation of mental disease.

The manner in which a nervous system, already brought to a state of lowered resistance by general ill health and defective nutritive processes, is readily affected by alcohol and provides a suitable basis for the development of a psychosis, is well illustrated in the following case:

A middle-aged man, who has been a hard-working school teacher for many years, reaching the involutive period of life, no longer is able to carry on his work with his natural interest and vigor. He finds that he can sleep but an hour or two at night, that he has lost his appetite for food and is failing in strength and losing weight.

He begins the use of a "tonic," largely alcoholic in composition, and he finds that it makes him feel stronger, better able to work for the time, and helps him to sleep. As the weeks pass on, he is obliged to increase the dose of alcohol until a weekly amount of at least a

quart is reached. In a few weeks more he again became nervous, depressed and worried. Delusions of persecution and hallucinations of hearing annoyed him to the extent that he attempted to set fire to the house in order to get rid of persons who, he thought, were seeking to harm him. Believing that the water-pipes leading into the house conducted the sound of his own voice to other houses through the main supply, he cut the pipes, hoping to prevent his persecutors in other parts of the town from hearing his conversation. He believed this possible because he heard the voices of others through the water-pipes. Following a change of environment, the elimination of alcohol and attention to the needs of his reduced physical state, prompt recovery followed within a few months.

Archdall Reid [4] cites an instance in which a clergyman, "who had been an abstainer all his life, was advised medically to take alcohol during an attack of influenza. He went like a stone to the depths—went in despair, weeping and praying for Divine aid."

As stated previously, alcohol may give rise to several types of mental derangement; it may do more than this: alcoholic psychoses may strongly simulate other forms of psychoses, because of the multiplicity of its symptoms. On this account the cases of alcoholic psychoses are variously named. Dividing then into classes, the acute and the chronic, the first includes only (1) pathological drunkenness; (2) delirium tremens; (3) acute alcoholic hallucinosis. Of the chronic psychoses there are several forms which present symptoms of mental disturbance as acute exacerbations of a chronic condition, marked by the predominance of hallucinations and illusions.

The various alcoholic psychoses are but the various phases the mental disorder may assume; all have as their fundamental symptoms the loss of the finer feelings and intellectual attainments (Berkley). To summarize, the cause of alcoholic psychoses, apart from drunkenness, is to be found not solely in alcohol but also in the individual predisposition. (1) The patient is a person who, in the first place, reacts to alcohol in an abnormal manner, who drinks in order that he may obtain a reaction which to him is a desirable experience; in fact, it is an experience which psychologically is a necessity for that individual. It becomes a means of quasi-adjustment; without the stimulating (?) effect he is incapable of meeting the conditions which the stern realities of life require. (2) The reaction may be the symptom of a psychosis or neurosis—*e.g.*, in manic-depressive psychoses, neurasthenic states, dementia præcox, paresis, head traumatic psychoses (including sunstroke) arteriosclerotic psychoses and imbecility.

Delirium Tremens.—The most frequent type of alcoholic mental disturbance, commonly spoken of as "the horrors," may be a mere episode in the life of the average chronic drinker. Few persistent drunkards escape an attack some time during a life of indulgence.

The cause of the attack is attributed to insufficient elimination of

the alcohol ingested, together with the production of secondary toxins resulting from defective visceral function. Based upon experiment, it is known that it requires forty-eight hours for the complete elimination of a dose of alcohol. When repeated doses have been taken, there is an accumulation of the poison in the tissues, the brunt of which may be borne by the nervous tissue. When the resistance is reduced below normal, there is a reaction brought about by perverted nervous function, which reaction may or may not be followed after several acute attacks by anatomical alteration with permanent damage, giving rise ultimately to the clinical picture of a terminal dementia. When there has been a sudden withdrawal of alcohol, there may follow a condition termed abstinence delirium similar to that which occurs during over-indulgence.[5]

The importance of sudden withdrawal of alcohol as a causal factor of the production of the delirium is an unsettled question. The fact should be borne in mind that in some cases there is reached a point of tolerance beyond which there develops the delirium in question which may have as one of its prodromes a repugnance against the taste for alcohol.

Symptoms.—There is usually a prodromal period of a few days before the onset of the delirium. There are disturbed sleep, restlessness, noises in the ears, stars floating before the eyes and mental irritability. Usually there are gastric irritability and anoræxia, some patients going without food for several days. In a day or two the typical delirium develops very suddenly; the restlessness is accentuated, and there are added marked disturbances of sensation. Of these hallucinations are the most prominent and are frequently of the visual type; commonly they are haptic and auditory; or all of these may occur in combination.

Furthermore, other contributing factors, such as head injury, are to be considered later, pneumonic infection, nephritis and other complicating infections.

Regis [6] states that alcoholic delirium is seen with equal frequency to follow mental and physical shock.

Hallucinations.—The hallucinations are numerous, varied and fleeting, though the habits of the patient may exert an influence upon the character of the hallucinations. The visual hallucinations are usually fantastic, grotesque or horrible—more often the latter, which may occur in rapid succession of changes. Hideous animals, devils and detectives pursue him; visions of dead friends or relatives in coffins appear, horrible scenes are enacted before his eyes. Sometimes these are recognized by the patient as being unreal. Commonly, in the actions of the patient in his delirium, may be recognized the occupation of the individual before the attack; the teamster drives his horses, the shopman sells his wares or decorates his windows. The presence of multiple forms of hallucinations and illusions is indicative of the severity of the confusional type.

Auditory hallucinations are next in frequency and are said to indicate a graver prognosis. These are often a confusion of hideous noises,

shrieks, whistles or bells. The patient may hear trains of cars coming down upon him, cries for help by someone being tortured. One man heard a woman inside the mattress crying out in pains of labor and calling to him to let her out. He may hear crowds of passing people who jeer at him, threaten him with terrible tortures. When auditory hallucinations occur they usually are associated with the visual, while the latter may occur alone.

Hallucinations of taste and smell are not frequent, but are more common than in other psychoses. When present, these are usually apt to give rise to the delusion that the food is poisoned.

Illusions.—The common symptom with which the laity is most familiar is the visual illusion in which the patient mentally transforms objects seen about him; figures on the wall-paper or in the carpet are mentally converted into horrible animals, devils or monsters; specks on the bed-clothing may be taken for vermin, which the patient ineffectually attempts to remove.

During the delirium the patient is disoriented; he greets the doctor and nurse as familiar persons. In spite of the confusion, he can, in his quieter moments, appreciate his environment, answer questions promptly and correctly, even describe his sensations and recent experiences, but he may be frequently interrupted by the appearance of the fleeting hallucinations which distract him for the time. The disposition of the patient is marked by a changeability; he is lively, agreeable, irritable and angry all in the same few moments. He may derive pleasure out of his visions, but more often they terrify him.

Tactile illusions are numerous and varied, possibly due to involvement of the cutaneous peripheral nerves, the disturbance of sensation giving rise to burning sensations, tingling, electric shocks, abnormal sensations of the generative organs, and the feeling that insects are crawling over the body or under the skin. All of these parasthesias, if the mind is sufficiently clear, may be distorted and result in delusions of a persecutory type. Neuritic pains may be interpreted as the effect of electricity governed by an unseen agency. Such persecutory ideas may lead to acts endangering the life of the patient, or may ultimately lead to attacks upon persons about him—his supposed enemies.

The presence of delusions depends upon the persistence and systematization of the hallucinations. If, after the mind has otherwise cleared, fixed delusions appear, there is a strong basis for the belief that the alcohol has been the exciting factor in the converting of a potential psychotic into a probable subject of chronic mental disorder (Mott).

Delusions are not common in the delirium, though persistent hallucinations may furnish a basis for their later development. The lack of mental control and consequent confusion in the early part of the delirium do not allow the production of fixed ideas, nor does the fleeting character of the hallucinations permit continuity of thought.

Motor Phenomena.—There are typically fine tremors in the face and hand muscles which cease momentarily when the attention is distracted or when some voluntary movement is made, as in drinking a glass of water. In severe cases there is muscular incoördination, but not true ataxia. There is general muscular weakness, and tremors may be seen involving most of the skeletal muscles, especially when muscular tension is increased, as in standing or sitting in a strained position, or when the fingers are forcibly extended. There is usually a marked tremor of the tongue when protruded, even though there may be no tremor of other muscles. Actual spasmodic twitching of the muscles or individual muscle bundles is often present in the severer types of the disorder. The gait is unsteady on account of muscular weakness. The reflexes are exaggerated in most instances. When there is a neuritis complicating the psychosis the knee-jerks may be diminished or absent. The temperature is usually elevated a few degrees; only in severe cases is there pyrexia. The pulse is weak and of low tension, although the carotids may appear throbbing. Commonly there is profuse sweating as the result of the extreme restlessness and consequent great motor activity.

Leucocytosis has been observed at the height of the delirium, later diminishing with the passing off of the delirium when the count may reach a subnormal, and afterwards gradually rising again to the normal. Albuminuria is almost constant, but severe nephritis is to be regarded as a complication.

After three or four days of delirium, incessant talking, insomnia and terrorizing hallucinations with fleeting delusions, the patient either passes into a sound sleep and recovers, or he enters a typhoid state with low muttering delirium and may die from exhaustion. Cold sweats are of bad augury (Bianchi).

In favorable cases recovery usually takes place in a week or ten days; others may be protracted to a fortnight or longer. When recovery is about to take place the patient begins to realize that his hallucinations are visionary, and brief periods of lucidity appear before the actual recovery is established.

The pathology of delirium tremens is a secondary manifestation due to the accumulation of toxins which are developed as the result of the action of alcohol upon the tissues of the circulatory system leading to passive hyperæmia, upon the kidneys resulting in defective elimination and to changes in the intestine leading to the production of toxins which is believed to give rise to the delirium (Boenhoeffer).

Anatomically there is marked œdema of the pia mater with an increase in the flow of the cerebrospinal fluid, which may be demonstrated by lumbar puncture with the fluid under increased pressure; microscopically, the ganglion cells show an absence of the granulation; swollen nuclei and vacuolation of the cell body. No increase in the number of cells is found in the spinal fluid. Defective elimination by the kidneys is believed to be largely responsible for the condition.

Diagnosis.—This, as a rule, is not difficult. Only in instances in which alcohol complicates another psychosis is there much room for doubt as to the nature of the malady. General paralysis presents difficulties in this respect when delirium is present. The absence of persistent delusions, visual hallucinations and illusions, together with the presence of physical signs, especially pupillary symptoms, is distinctive; also, the prodromal change in character and personality usually serves to guide in the diagnosis of paresis.

Treatment.—The essential treatment of delirium tremens is that of a collapse delirium. The urgent demands are the removal of the alcohol, the supplying of a liberal amount of nourishment and the production of rest. The two symptoms which require attention are the restlessness and gastric irritability. Food is an absolute necessity; the form of easily digested food that can be retained is the one to administer in small quantities and at frequent intervals. In this way only can the demands of a weakened economy, together with feeble digestive powers, be supplied. If there is marked gastric irritability, lavage and artificial feeding may be required.

For the anorexia, nux vomica and capsicum are important aids. Thorough evacuation of the bowels is of paramount importance on account of the constipated habit of the average alcoholic and the need of elimination. The withdrawal of the alcohol will be a matter to be determined in each case. This, of course, must be done as quickly as possible, consistent with the safety of the patient. Sudden withdrawal may be accompanied by an aggravation of the symptoms, or may be followed by circulatory collapse. In all cases it is well to replace the alcohol with cardiac stimulants, of which strychnin is the most important.

The patient should be confined to bed and a nurse should be in constant attendance. Frequent warm sponge baths are important aids in favoring elimination and have also a calmative effect. Rest may be secured in several ways. Rest in bed is of prime importance. Hydrotherapy in the form of sponge bath, prolonged bath, douche and hot packs is of service. The tub bath, however, can be used to better advantage when the patient is physically strong. To combat the insomnia the selection of an hypnotic is a serious matter in some cases.

In robust individuals with strong pulse the bromides, in combination with chloral, given cautiously, will usually answer well. Feeble heart action frequently contraindicates these drugs, and for that reason trional, veronal and paraldehyde are valuable and comparatively free from danger attending their use. Hyoscine hydrobromate, gr. 1/100, hypodermically may be used. As little drugging as possible is the best rule to follow, using by preference other methods of sedation. After the acute stage has passed, tonics for the digestive and circulatory system are indicated. Outdoor life, mild exercise and an occupation tend to promote rapid recovery.

Ranson and Scott [7] consider the alcoholic delirium as presenting two

sharply defined stages; an incipient stage of insomnia, restlessness and tremor with occasional hallucinations, which the patient recognizes as such, followed later by visual hallucinations, which are not interpreted as such, with delirium, fever, profuse perspiration and moderate leucocytosis (7000 to 9000). These observers regard the use of hypnotics as of greatest value in the early stage of the disorder by preventing the transition into the second or delirious phase, shown by the fact that of 112 cases treated with chloral 25 per cent. developed delirium, while of 590 cases not treated with chloral 41.3 per cent. developed delirium.

The use of morphine was found to be followed by delirium in 35.9 per cent. in incipient cases, the authors concluding that the drug is both "useless and dangerous." In regard to hyoscine they found that it is "undoubtedly worse" than morphine, as shown by the fact that of the incipient cases in which hyoscine was used 32.2 per cent. became delirious, while 39.3 per cent. became delirious without hyoscine; on the other hand, the highest mortality rate was found among those treated with hyoscine, 50.7 per cent. of cases died, while 34.3 per cent. died among those not treated with hyoscine. Only 14 per cent. of their cases treated with veronal developed delirium, and 21 per cent. of the delirious cases treated died.

In regard to the use of alcohol the same writers found that, in the early stage the use of alcohol, about one ounce of whiskey four to six times daily was followed by a delirious stage in 24.3 per cent., while of the cases not given alcohol 44.6 per cent. developed delirium. In the second stage cases the mortality was slightly less (1.7 per cent.) when alcohol was given.

In some cases lumbar puncture is made to relieve the intramembranous pressure. Hoppe [8] treated 129 cases by lumbar puncture, circulatory stimulation, administration of alkalies to diminish acidosis and catharsis with a mortality of 7.6 per cent.

Acute Alcoholic Hallucinosis.—This group represents the acute exacerbations of mental symptoms in alcoholics, with a sudden appearance of delusions, usually of a persecutory type, based upon hallucinations of hearing, and with little or no clouding of consciousness.

Etiology.—The disorder occurs during or after middle life, following a long period of indulgence in alcohol. Persons known to have been seldom intoxicated, but who have been steady drinkers and habitual tipplers for years, may develop this form of psychosis.

Symptoms.—The onset of the attack usually appears suddenly after a period of prodromes. Frequently the attacks are regarded simply as an indication of overindulgence and are initiated with headache, malaise, dizziness, insomnia and mental irritability. The first pronounced mental symptoms often occur at night.

Hallucinations are a conspicuous symptom. The patient may be aroused from partial sleep by hearing sounds, which he believes are those made by someone trying to enter the house. He may be reassured

for the time, but soon has a repetition of the experience which may be intensified by more or less confusion.

The hallucinatory experiences grow more frequent day by day until he is more or less constantly dominated by ideas based upon his sensory disturbances. Visual hallucinations are not common, and if present play an unimportant part in the psychosis. When present they are more frequent at night and occur as terrifying visions, apparitions, shadows of detectives who are watching him. Cutaneous sense disturbances and tactile hallucinations are common in the form of electric currents, burning and stinging sensations. Hallucinations of taste and smell are less common and are usually of a disgusting character.

Consciousness, as a rule, is clear and environmental data are properly apprehended. At night when the patient is awakened from his disturbed sleep there may be transitory confusion.

Memory shows little if any involvement, and orientation is complete.

Attention is easily diverted by the hallucinatory experience, though the patient may be able to concentrate sufficiently for a time to permit him to continue his occupation.

Emotionally he is apt to be depressed, anxious, fearful and irritable. Not uncommonly there are outbursts of anger in which the patient threatens his supposed tormentors.

The train of thought is disturbed by the sensory falsification and the state of fear. The ideas are centred about his fear of being injured, arrested or executed. Otherwise the train of thought may be entirely coherent when the attention is held to the discussion of other topics.

Judgment is controlled largely by the hallucinatory experiences, hence delusion formation is a conspicuous part of the disorder. The patient is self-centred and also believes that other persons are constantly watching him. On this account he becomes suspicious, fearful, distrustful. He believes that he is threatened, maligned, jeered at by passersby, and that detectives follow him at every turn. Fellow-workmen are interfering with his work and deliberately plan to place difficulties in his way. Sometimes there is a tendency to the systematization of the delusions. One patient believed that the foreman of his shop was his chief enemy, in consequence of which all the workmen were obliged to enter into the scheme for fear of losing their own positions.

In behavior the patient may present no variations from the normal for some time. He may continue at his occupation until the annoyances of fellow-workmen become so great that he can stand it no longer. He may complain that he is taunted, sneered at and ridiculed or insulted. He is told that his children are not his own; that his wife is unfaithful. On account of extreme suspicion, the patient may refuse to speak; he may refuse to leave the house for fear of being arrested. He may go so far as to provide himself with weapons of defence and barricade himself against all who attempt to enter his room.

Course and Prognosis.—The psychosis may be of either a few weeks' duration or may last for several months. If sudden in onset with acute manifestations the course is usually shorter. De Fursac [9] observes that motor hallucinations in which the patients feel their bodies being moved or shaken are significant of a grave prognosis; that is, a long course and a tendency towards intellectual enfeeblement.

The outlook in most of the cases is favorable. Recurrences are common with the return to the use of alcohol; each attack is apt to be of longer duration than the preceding one. In a few cases there is a continuance of the hallucinatory phenomena and the delusions with gradual development of mental deterioration.

Chronic Alcoholism

Persons who have been the subjects of long-continued inebriety may suffer attacks of mental depression or excitement, running either an acute or subacute course, ending in prompt recovery after a period of abstinence from alcohol, but with a strong tendency to recurrence with each debauch. The psychoses in other cases may be chronic from the beginning, and the course of the disease remain unchanged for many years, or it may progress more or less rapidly and terminate in a chronic state of mental enfeeblement.

Pathology.—The subjects of a more or less continued alcoholism show at post-mortem examination the effect of a slowly acting poison which gives rise to a general arteriosclerosis, also thickening of the meninges and sclerotic changes in the brain, stomach, kidneys, liver and pancreas as the result of general vascular disease.

Mental and physical degenerative changes accompanying chronic alcoholism are not confined to the individual in question, but as a result of the lowered vitality of the parents there appears a distinct defect in the descendants in the form of mental and moral imbecility, deaf-mutism, sterility; the latter, according to some observers, seems to be evidence of an attempt on the part of nature to bring about the extinction of the unfit type.

The fundamental cerebral pathological changes in alcoholism are to be found primarily affecting the vascular system, and are characterized by an endarteritis affecting chiefly the cortical gray substance where the terminal vessels exist in greatest number. The larger vessels of the base of the brain and in the large fissures may be the seat of sclerotic or atheromatous patches. In advanced conditions there are infrequently leptomeningitis (chronic) and pachymeningitis, in some instances with hematomata. There is a diminution in the weight of the total brain substance; the convolutions are shrunken, the ventricles dilated and the ependyma granular in some portions. Microscopic examination shows a moderate thickening of the pia, especially at the base of the brain. In preparations stained by the Nissl method, the nerve elements of the cortex appear in various stages of disintegration, shown by the chroma-

tolysis of the cystoplasm; advanced changes appear in the form of shrinkage and atrophy of the cortical neurones, with displacement of the nuclei and cell vacuolation. In some instances the changes in the cells seem to have involved the dendrites only and a reparative process may therefore take place, which thus accounts for the recovery in some long-standing cases (Berkley).

The Polyneuritic Psychosis (Korsakow's).—This form of alcoholic psychosis is by some regarded as a severe and protracted form of delirium tremens. Similar clinical pictures are seen in toxic conditions arising from some of the infectious diseases, and also are associated with the mental disorders of the puerperium. The intimate relationship which Korsakow's syndrome bears to alcoholic intoxication has given rise to the use of the term in connection with a definite type of mental disorder of alcoholic origin. Although neuritic symptoms are not always present, the mental state is usually characteristic and is marked by a "profound disturbance of the impressibility of memory, disorientation and a tendency to fabrications of memory" (Diefendorf).

Etiology.—The excessive use of alcohol is by far the commonest direct cause. It is especially apt to occur in those who have previously suffered attacks of delirium tremens. Women are said to suffer more frequently than men. Alcohol is found to be the cause in at least three-fourths of the cases, although the syndrome has been observed after typhoid fever, influenza, childbirth, pyæmia, arsenical and, perhaps, lead poisonings. In all the cases occurring in women there have been marked neuritic symptoms.[10] The majority of cases occur between the ages of thirty and fifty. Mott states that it is more apt to occur in individuals with inborn stable mental inheritance than in the unstable.

Pathology.—The pathogenesis of this disorder is by no means clear. It is believed to depend not upon the direct action of alcohol upon the nervous tissue, but is regarded as probably due to the toxic effects of deranged metabolism, a secondary toxemia from disordered function of viscera which have been injured by alcohol.

Although the physical signs are those of a multiple neuritis, the pathology of the disease is not limited to the peripheral portions of the neurons; in fact, there are acute and chronic degenerative changes throughout the central nervous system. The cell bodies and cell processes and the nerve fibres from the cortex to the periphery are here and there involved in the degenerative process. Blood-vessel changes are widespread, both inflammatory and hemorrhagic. In some instances there are hemorrhagic areas in the midbrain involving the nuclei of the cranial nerves, especially ocular palsies, producing the **polioencephalitis hemorrhagica** syndrome of Wernicke.

Symptoms.—The onset of Korsakow's disease frequently begins in the same manner as delirium tremens, but differs from it in that the characteristic mental disorder follows an initial period of delirium,

with a continuation of the mental confusion and the disturbance of emotion.

In grave cases a state of stupor develops which may terminate either in death or may be followed by permanent mental enfeeblement. Conspicuous among the mental symptoms is the memory defect and disorientation. The memory disorder is one of the forms of amnesia and usually involves impressions of the immediate present as well as those of the past, on account of the fact that reproductive memory is equally disordered.

The most characteristic fact connected with the memory disorder is the tendency to fabrication. This disorder of memory seems to be analagous to hallucinations of the senses in that there is falsification of memory which leads the patient to give expression to ideas relating to experiences which have never happened. The period for which the patient is really amnesic is bridged by pseudomemories, which the patient relates with utmost fidelity. These memory falsifications have also been termed "illusions and hallucinations of memory." For example, a patient, who had been in the hospital many weeks and bedridden on account of the neuritic paralysis of both legs, when questioned in regard to her recent experience, said that she had arrived at the hospital that day and that she was in bed because she had sprained her ankles while on the way downstairs that morning. These patients show a characteristic emotional indifference, with entire lack of insight. In some instances the hallucinatory phenomena of the initial delirium extend over into the polyneuritic phase.

In some of the milder cases the real mental defect is not noticeable at first sight, especially if the mental examination should not involve the activity of the memory processes. The disorientation soon makes its appearance; and the mental clearness, which is more apparent than real, is replaced by the clouded state.

Physically there are the usual signs of multiple neuritis, which may vary greatly in intensity. Paralysis of the extensors of the extremities with footdrop alone or with wristdrop is commonly present. In milder forms there may be only weakness or partial paralysis of the extremities with tenderness along the course of the affected nerve trunks and with diminished or absent reflexes, pain and parasthesias.

Pathologically there are widespread lesions throughout the nervous system involving the peripheral nerves, the conduction pathways, basal ganglia and cerebral cortex.

The duration of the disease is prolonged over many months at least, and always is to be regarded as a grave disorder. Some patients recover except as to the memory disturbance, which persists as an amnesia covering recent events. In other cases the recovery seems almost complete but with some memory defect.

In the graver cases death may occur as the result of involvement of the respiratory nerves or from an intercurrent infection.

Treatment.—In the grave forms with severe delirium the treatment should be directed along the same lines as in delirium tremens. The general condition requires supporting and tonic treatment, in addition to which special attention must be given to the paralytic symptoms directly due to the neuritic involvement. In the early phase of the disorder, as in non-delirious types of multiple neuritis, it is well not to institute very active local measures for the paralytic symptoms. The paralyzed extremities should be supported in partial flexion in order to avoid continued stretching of the palsied extensor muscles, especially by relieving the extensors of the foot by supporting the footdrop. Within a week or two light massage should be begun with the idea of maintaining muscle tone as far as possible. Later, as evidence of returning power appears, very moderate exercise should be increased together with massage, and faradization may be employed.

Chronic Alcoholic Hallucinosis.—This type of alcoholic psychosis usually appears after a short prodromal period, though it may be of gradual development, and in some cases it appears as the residuum of an acute attack. Then mental state is characterized by persistent delusions of persecutions which arise from hallucinations.

The prodromes usually appear during the period when the patient is recovering from the immediate effects of continued abuse of alcohol, and are marked by headache, disturbed sleep, vertigo and other circulatory disturbances, which may become so pronounced that the patient may express fear concerning his physical condition. There follows a more or less sudden appearance of hallucinations, more commonly of hearing than of sight. These are usually in the form of voices, which threaten the patient or taunt him with maligning accusations. Commonly the voices refer to the reproductive organs, or sexual matters; he is told that he is impotent or a sexual pervert, or that his wife is unfaithful. Disturbed cutaneous sensations, especially in the region of the sexual organs, add to the reality of the auditory hallucinations, and out of these sensory disorders is developed the common delusion, marital infidelity, regarded as being as nearly pathognomonic of alcoholic disorder as any one symptom can be in the diagnosis of mental disease.[11]

Frequently there are associated delusions of poisoning, based upon hallucinations of taste and smell. Unseen enemies torment him with currents of electricity run through wires in the walls of his room, thus to destroy his brain or ruin his stomach. The cutaneous sensations give rise to the belief in the electric origin of his discomfort, and the voices referred to in the walls or ceiling account for the belief that there are persons on the roof or in the floor below directing the infliction, On account of the continued annoyance, the patient, after a time, seeks aid from his friends or protection from the police or, as sometimes occurs, voluntarily seeks entrance into an institution.

In some patients there develop grandiose and egotistic delusions, arising from the conclusion that the torment is the result of the jealousy

of his enemies on account of his personal greatness or riches. Such a train of symptoms is of bad prognostic significance. Many of the patients show the physical signs of chronic alcohol poisoning, indicated by tremor of the face and hands, exaggeration of the reflexes and general muscular weakness, hyperæsthesia, paræsthesia and anæsthesia.

The disorder necessarily runs a chronic course with exacerbations and may terminate in dementia. A few patients of this class recover sufficiently to leave the hospital, but usually return.

In general, it may be said that even during periods of abstinence and apparent freedom from active mental symptoms there are noted mental changes which affect the individual's habits. The patient assumes an altered attitude towards his business, family and friends. He is apt to place the blame for his condition upon others, while in reality he is the cause of the difficulty. He loses interest in his family, is easily irritated by their presence and feels the need of new associations. He loses interest in his business and, in fact, cannot carry on his work except under some degree of stimulation. At the time of the return of the desire for excessive stimulation the patient may resort to every form of irregularity, if need be, in order to obtain alcohol. He will associate with persons far below his social plane without concern as to the effect it might have upon his business, family or social status. His moral sense gradually becomes more enfeebled, and the emotional irritability increases as the protestations against his actions are often followed only by violent outbursts of temper. In the earlier phases of the disorders, remissions are apt to be marked by depression, profound remorse and repentance and by an expression of a strong desire to change his habits, never consummated, however, on account of his weakened will.

Alcoholic hallucinatory dementia may begin as a chronic form of psychosis or may be an end phase of acute alcoholic hallucinosis. After an attack of one or other of the preceding types of disorder the symptoms may subside, only to return in milder form but with a greater degree of fixity, to which is added a moderate grade of mental deterioration.

Symptoms.—Hallucinations are numerous and persistent, involving chiefly the auditory and tactile senses. Threatening voices and sounds of electrical devices which are operating upon the patient's body are heard. Dictaphones are placed in the walls, through which they hear persons at a distance. Hallucinations of tactile and organic sensations are common. The patients feel that they are operated upon by various kinds of machines and that by chemical means their organs are being changed; paræsthesias or tactile illusions often are referred to the reproductive organs. One patient experienced sexual maltreatment by persons at a distance, also felt that his intestines and other organs were taken out of his body.

The hallucinations are always productive of **delusive** ideas, which are more or less fixed and expressed many times daily in the same style of speech content. The delusions are usually of a highly improbable nature and may even savor of the fantastic and impossible. In general matters the patient shows more or less alertness and clarity in regard to the ordinary affairs of life, but nevertheless presents signs of unmistakable mental enfeeblement. Although able to show a certain amount of interest in his environment and perhaps usefully employed, he is in general little concerned about the future; he is lacking in true insight and has no well-founded explanation for his condition.

Emotionally he may show excessive depression or irritability in the early phase of the disorder, but later is pleasantly disposed towards his associates and often develops a good-natured and philosophical attitude in regard to his annoyances.

Course and Prognosis.—The course of the disorder is essentially chronic and progresses as long as alcohol is available. Under control and freedom from alcoholic indulgence, the active symptoms may disappear, while the general mental condition of the patient presents an uncomplicated enfeeblement or dementia. There may be transitory reappearances of the hallucinatory experiences which give rise to a return of the original or similar delusive ideas.

Alcoholic Paranoia.—As already indicated, alcoholic psychoses may appear in the form of a delirium or an acute hallucinosis, from which either the patient may recover or may pass into a terminal state of moderate dementia. In subjects who are of strongly neuropathic disposition, neither recovery nor dementia ensues, but there develops instead a distinct paranoid trend. In other cases there develops very insidiously an alcoholic paranoia. In many cases the strained relations which commonly exist in the family of the alcoholic and on account of his increasing sexual impotency and the widening gap between the affections of the husband and wife there develops an attitude of jealousy with delusions largely sexual and persecutory in content.

The husband accuses his wife of infidelity, which he believes to be supported by accidental and coincidental happenings when he is in his wife's company; totally irrelevant occurrences are construed by the patient to be fully significant of the correctness of his belief.

Unfortunately the delusive ideas are commonly not of an impossible character, so that at times it is difficult to separate the statements of the patient containing facts from those which are the outcome of his altered attitude.

Consciousness is clear and ordinary experiences are thoroughly comprehended. Commonly the patient continues with the usual routine of business and social affairs, and may even give no signs in his actions that he entertains the delusive ideas in regard to his wife.

Hallucinations are not present to the extent that they are met in the other alcoholic psychoses. When present they are usually indefinite and are spoken of by the patient as peculiar sounds, which he interprets as footsteps of men who are stealthily leaving the house, the rattling of a doorlatch, a whispering voice. The senses of taste and smell are frequently falsified, giving rise to hallucinations, spoken of as peculiar odors in the house or poison in the food.

Emotionally the patient shows increased irritability, loses his temper quickly, at which time he may use violence towards the object of his jealousy.

The *conduct* may show no irregularity for a long time until some episode brings forth an outburst of anger or accusations against his wife for her supposed unfaithfulness. When the patient is supplied with a store of alcohol he is likely to be more irritable, abusive and destructive. Occasionally serious assaults are made in an attack of drunken fury.

Morphinism.—Under this head are included the mental and physical conditions which arise from the habitual use of any of the preparations of opium, such as paregoric or laudanum, the alkaloid morphin and its derivative, heroin. The " drug habit " is the outcome of the more or less regular ingestion, at first of small quantities, later increased, until in some instances fifteen or twenty grains of morphin may be used in the day. Habitual users, of morphin especially, comprise two groups: The first group includes persons who have taken the drug for the relief of pains; among the most numerous are sufferers from headache, migraine, neuritis, neuralgia, tabetic crises, and the vomiting of pregnancy.

The second group, possibly the more common among certain classes, comprises persons who have formed the habit by association with other addicts and by example or " experiment."

The first group of patients includes persons who, by reason of their inherent instability incident to the neuropathic constitution, are unable to bear pain to the same extent that the more stable may be, and who, by the same means, become easy victims of the drug habit.

The exact manner in which the morphin habit develops may differ with different individuals. In those who have become addicts by taking the drug for the relief of pain, there commonly is experienced with the initial dose a well-defined feeling of well-being, the sensation of pain being replaced by a period of pleasant sleep, provided the individual has not gained a tolerance for the drug. In persons in whom a tolerance has become established, a certain degree of stimulation occurs with each dose, lasting a variable time, but invariably to be replaced later by profound distress and a feeling of ill-being, which only those habituated know but cannot describe. As the practice continues the dosage must either be increased or the intervals between doses short-

ened. It becomes ultimately not a matter of gaining pleasurable sensations from the drug, but relief from discomfort, due to its absence; and the time finally arrives when, in order that the life may be bearable, the subject must be more or less constantly narcotized. The abstinence symptoms are regarded by some observers as due in part to a secondary intoxication, through the chemical change which takes place in the accumulated morphin which is converted into oxymorphin; this becomes a toxic agent to which the organism is unable to accommodate itself, and, as an antidote, nothing but morphin is effectual. Beyond a certain point, however, instead of neutralizing the accumulated toxin, the increase of the dosage of the drug only serves to aggravate an established vicious circle, for the reason that only a limited amount of the drug can be taken by the tissues, and, therefore, ultimately the patient does not absorb sufficient to relieve his distress.

Symptoms of Chronic Morphinism.—The confirmed addict presents mental and physical symptoms and physical signs which are fairly definite.

In general, the condition at once suggests physical reduction and a marked impairment of nutrition. Most patients in this class are thin and anæmic in appearance. The skin is apt to be sallow, dry, harsh and devoid of its usual elasticity, hence the face commonly shows wrinkling resembling senility.

The pupils may be well contracted if a recent dose of the drug has been taken, otherwise moderate dilation may be observed.

Likewise, when out of drug, these patients show marked muscular weakness with or without tremor and muscle hypotonia. The reflexes are often increased. There are superficial and deep hypersensitiveness and often tenderness in spots over the body and extremities.

The circulatory functions are depressed, the pulse slow, small and compressible, the heart sounds weak and the action irregular. The peripheral circulation is poor, as is shown by cold and cyanotic extremities.

Digestion is impaired, the appetite poor, the tongue coated and mouth dry. Constipation is the rule and is favored by the patient for reasons stated later. In extreme conditions a state of asthenia develops, so that the patient becomes a helpless invalid.

Mentally there is a characteristic sluggishness, which disappears transitorily following each dose of morphia. As a rule, the patient loses interest in his accustomed pursuits, family and friends and seems generally indifferent towards everything but himself. Emotionally he is irritable when not indifferent. His judgment and consequently his idea of proportion are notably lacking. All sense of responsibility and regard for the truth disappear; he will resort to all sorts of devices and sacrifice self-respect in order to obtain his desired drug. Insomnia and restlessness are persistent except while the patient is under the influence of morphin.

Abstinence Symptoms.—In the majority of instances the symptoms which accompany the reduction, or attempt at withdrawal, of the drug are referred to the nervous system and the circulatory system through the sympathetic. There are commonly cardiac palpitation, a weak, running pulse, pain in the gastrointestinal tract, nausea, vomiting and diarrhœa. Many patients taking morphin object seriously to allowing the bowels to become loose. This is doubtless due to the fact that the patient knows, by experience, that when the amount of drug in the tissues is running low the desire for its renewal will follow, which can often be foretold by cramps and diarrhœa. If the intestinal secretions are active, the drug is eliminated more rapidly and in turn hastens the return of general discomfort which invariably follows a reduction in the store of drug in the tissues. Respiratory symptoms, such as yawning, sneezing and dyspnœa, are common. Tremors, muscle pains and weakness are often accompanied by severe muscular cramp-like pains. First there are apt to be photophobia (pupillary dilation), yawning, sneezing and the characteristic "cold in the head" of the morphin addict, followed by the more active signs of discomfort.

In persons who have begun taking the drug for the relief of a definite symptom, such as vomiting, headache or the pain of tabetic crises, the first symptoms to appear, when the dose is missed or reduced beyond tolerance, will be the return of headache or vomiting or pains as the case may be. These patients are usually in a reduced physical and mental condition either as the result of the suffering or disease process, and consequently the problem is made more difficult.

Furthermore, the inherent instability of these patients makes them unable to accomplish anything by their own effort, and they accordingly are forced to depend entirely upon the others managing the case. It should be emphasized that the abstinence symptoms of morphin cannot be relieved by any known means at our command but by the administration of morphin. The patient suffers not only a "hunger" or "craving" for the drug, but, if this be allowed to continue for sufficient length of time, there commonly develop additional symptoms both of physical and mental origin.

Prominent among the physical symptoms is marked motor restlessness, with aching of the leg and arm muscles, pain in the gastric region, nausea and diarrhœa. In some instances more serious symptoms develop, as vertigo; visual disturbances, such as blindness, chromatopsia, drowsiness, feeble pulse, sweating and threatened collapse. There is marked mental irritability, the result of suffering, which may become extreme and lead to violence. The perversion of the moral sense, especially during periods of deprivation, is characteristic in these patients and they are noted for their tendency to resort to extreme measures in order to obtain the desired end.

A patient in the writer's experience would not make known her discomfort until it became so manifest that she was no longer able to

conceal it. The initial sneezing was always due to "taking cold"; later would appear neuralgic pains in the occipital region, passing forward to the brows, the photophobia, nausea and prostration with palpation. By this means she thought that she would be more apt to receive her maximum dose and thus gain the desired stimulation effect.

Prognosis and Course.—In general, it may be said that the prognosis is always grave from the standpoint of the probability of complete recovery. A few patients are able to gather themselves together sufficiently to aid in their recovery; this number would approximate 10 per cent. of the cases treated. A very small number of patients acquire the habit as the result of having been given the drug for pain or insomnia. The larger majority of the severe types of drug addicts are of strong neuropathic constitution in whom relapses are the rule. Like the alcoholic the morphin addict is often of such mental constitution that he is unable to make adjustments to different situations, and, in fact, sooner or later the ordinary adjustments of life become difficult for him. A small percentage of persons are able to get on comfortably for many years upon a moderate dose of the drug. The true neuropath, however, drifts into a state in which he cannot help himself. The dosage of the drug is increased until a condition is reached in which the only comfort in his existence is derived from the effect of the drug. Ultimately, as the result of long-continued saturation and the development of secondary toxins, a condition of cachexia develops. Any attempt at reduction produces extreme suffering, and finally the patient dies from the effect of an overdose of the drug or from circulatory collapse.

Treatment.—The best treatment of the morphin habit is prevention. It might be a good rule to follow, in the matter of administering morphin for the relief of pain, to exert more than ordinary vigilance in the instance of the patient who reacts to morphin in terms of pleasurable sensation, in addition to the relief of pain for which the dose was given. Many persons experience a discomforting reaction, as headache, nausea, colicky pains, when given the average therapeutic dose of morphin. With the exception of persons who might deliberately try to acquire the habit, individuals of such reaction types are not likely to acquire the habit. In beginning to attempt the treatment of the morphin habit it is most essential to determine the amount of drug the patient has been taking. This is not always an easy matter, because oftentimes the patient is unable to give the proper information through actual ignorance or because of the fact that he is often not able, on account of his mental state, to tell the truth. The first object in the treatment is necessarily the removal of the drug. In instances in which the drug is taken by mouth the reduction, especially the initial reduction, can be made rapidly. In patients taking by mouth more than ten grains of morphin in the day the initial reduction can usually be made nearly one-half on account of the fact that more than that amount is not absorbed, the excess being eliminated by the bowels.

In patients taking the drug by hypodermic injection the reduction is more difficult from the beginning, requiring careful study of the individual reactions to determine just the amount sufficient to keep the patient comfortable without any stimulating effect. Stimulation means an excess of drug over that needed to maintain the balance of nervous and metabolic processes. The second object of treatment includes the meeting of the reduction symptoms and the employment of measures to increase the resistive powers both physical and mental.

Some patients are able, with a certain amount of aid and a great deal of encouragement, to break themselves of the habit with comparatively little discomfort. This is more apt to be true of those who have been taking the drug for no reason other than the relief of suffering from pains of disease. It is in this group that the so-called "quick cures" are so successful. Such a patient, if coöperative, can be treated successfully if put under the care of a reliable nurse and removed from his original environment. The reduction should be made as rapidly as possible, consistent with safety to the patient, and it is well not to let the patient know when all of the drug has been withdrawn. If morphin is given by mouth, the doses given during the last few days can be given in a suitable menstruum and the menstruum continued without the drug for several days more. In the case of patients receiving morphin hypodermically, the same plan can be carried out, using normal salt solution as a vehicle and finally normal salt solution alone. Next to the withdrawal of the drug, the elimination of accumulated toxins is of most importance. This is probably best accomplished by free purgation with the vegetable cathartics combined with one of the preparations of belladonna. Supporting tonics for the reduced physical state, outdoor life, moderate exercise, occupation and diversion are called for during convalescence. Of great importance is the after-treatment in supplying the necessary moral support, elimination of temptation and development of new mental habits.

Cocainism.—Like the morphin habit, cocainism may arise as the outcome of the experience derived from the medical use of cocain in the form of prescriptions for snuffs, sprays and other local applications, such as salves and ointments applied to the mucous membranes. In some cases the habit is developed through force of example of other addicts. Not infrequently the cocain habit develops as an outgrowth from the morphin habit, the cocain being taken to counteract the somnifacient effect, or for the purpose of reduction of the dose of morphin. Still other habitués who are also alcoholics have acquired the cocain habit as the result of its employment for the relief from the depressing after-effects of excessive alcoholic stimulation. Some persons are victims of all three narcotics, shifting from one to another for the purpose of counteracting any particular uncomfortable effect. One patient in the writer's experience, an alcoholic, had acquired both the morphin and cocain habits and required sixteen grains of morphin and nineteen

grains of cocain daily to keep him comfortable at the time his treatment was begun. A reduction in the amount of either of these drugs could be detected by the patient with remarkable acuteness, the prominent reduction symptom occurring in the form of distressing asthmatic attacks, with the appearance of large moist bronchial râles and dyspnœa.

Symptoms.—The physiologic effect of a dose of cocain is one of pleasant stimulation and a feeling of exhilaration, a sense of pressure of activity and a state of euphoria, which the addict seeks to experience for a time only, but later, as in the case of the morphin habitué, a certain amount of stimulation is necessary for his comfort.

During stimulation the patient is active, talkative and gives the appearance of a general feeling of well-being. The rate of the pulse is increased, the face flushed and the pupils dilated.

As in the case of the morphin addict, there later appear disturbances of nutrition and cardiovascular irregularity. There is general physical weakness and finally a state of cachexia develops. Abstinence symptoms as a rule are not as severe as is the case in morphinism.

Mental Symptoms.—The mental symptoms are more prominent in cocainism than in morphinism. Sensory disorders are common and quite characteristic, occurring as tactual paræsthesia. They are interpreted as itching, biting, crawling and sticking sensations, which the patient attributes to the presence of insects. So common is this symptom that it has been given the name of the "cocain bug." Other sense falsifications may be present, but are less common. Visual, auditory, taste and smell sensations may occur irregularly. Voices and "whisperings" are complained of by the patient; sometimes terrifying sounds are heard, and also visual hallucinations occur similar to those of alcoholic delirium. Patients frequently complain of sexual impotence.

Consciousness may be so clouded at times as to give rise to mental confusion or a state of delirium.

Insomnia is persistent on account of the stimulating effect of the cocain.

Emotionally there are marked irritability, extreme selfishness, suspicion and at times marked depression. As already indicated, when under the effect of stimulation, there is emotional exaltation with a feeling of well-being.

Train of thought is rapid and active during stimulation, but otherwise is sluggish, and there is marked reduction in the capacity for continued mental effort.

Judgment shows marked defect, reasoning is superficial, snap judgments are formed upon a basis of suspicion. Commonly a paranoid trend develops; ideas of persecution and of the patient's right unduly curtailed by "needlessly concerned relatives." As the result of the interference with the sexual activity, the patient may believe that he has been given a drug to cause impairment of his sexual function. Ideas of marital infidelity may arise upon a similar foundation.

Treatment.—The withdrawal of the drug is usually much more easily accomplished in cocainism than in the case of the morphin habit. When untoward symptoms occur they can usually be more promptly controlled, except in instances like the case above, in which there arises some particular distressing symptom.

The chief symptoms to be met are the depression of spirits and the lack of circulatory tone. Sleep usually returns after the withdrawal of the drug. It should be noted that the abstinence symptoms may not appear for several days after the drug has been stopped. The same condition should be observed in safeguarding the patient from the opportunity to obtain drugs, and at the same time the patient should be carefully watched on account of the fact that residual paranoid delusive trends may continue for a time.

The prognosis is unfavorable for complete recovery, although it is good for the reduction period. Relapses are frequent.

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CHAPTER III

PARALYTIC DEMENTIA, PARESIS, GENERAL PARALYSIS, PARENCHYMATOUS NEUROSYPHILIS

REACTIONS DUE TO SPECIFIC TOXIC, INFLAMMATORY-DEGENERATIVE CHANGES IN THE PARENCHYMA OF THE CENTRAL NERVOUS SYSTEM, CHARACTERIZED BY EARLY INTELLECTUAL DEFECTS AND WIDESPREAD PHYSICAL SIGNS OF NEURONIC DEGENERATION

General paralysis is a chronic mental and physical disease, usually occurring in middle life. It has for its anatomical basis an affection of the general nervous system, occurring in individuals in whom there is evidence of previous luetic infection.

The disease is characterized mentally by progressive deterioration, which may be accentuated by attacks of a maniacal, depressive or confusional character, and ultimately terminates in complete dementia. Physically, the disease is characterized by paresis, incoördination, muscular tremor and weakness and commonly by paralytic or epileptiform seizures which may terminate fatally; also, death may occur from exhaustion or intercurrent disease.

Pathologically, paresis is characterized by neuronic degeneration, accompanied by a subacute or chronic inflammation of the brain and its membranes, which may invade the entire cerebral cortex, cerebellum, spinal cord and peripheral nerves, and even secondarily affect the osseous, cartilaginous and muscular tissues.

Descriptive accounts of the clinical concurrence of mental disorder and paralysis appear as early as 1672 by Willis, and by Haslam in 1798, but neither of these writers describes the mental and motor symptoms as coexistent manifestations of the same disease.

Among the early writers, Pinel, Esquirol and Georget regarded the disorder as a complex of symptoms only; that is, as mental disorder superimposed upon organic nervous disease.

The first account of the disease in which the mental and paralytic symptoms were described as a single disease process, a chronic arachnitis, was that given by Bayle [1] in 1822. Calmeil, in 1826, described the condition in an extensive monograph [2] and considered the disease as a chronic periencephalitis. In 1846, Baillarger stated that dementia is the essential symptom of the disease, accordingly proposing the name paralytic dementia, now generally used. In 1858, the French Medico-Psychological Society confirmed the unity of the disorder and agreed that it should be regarded as a clinical disease entity.

Etiology.—Paresis is an affection which appears to belong especially in modern life and on this account was termed by Krafft-Ebing

the disease of "civilization and syphilization." Its most frequent occurrence is found in western Europe and Northern America, in largely populated districts, rather than rural districts. Macpherson, in 1899, stated that paresis was not found in the highlands of Scotland, or in Ireland outside of the large cities, or in the more remote districts of Wales and the south of England. All these classes, however, have been shown to lose their apparent immunity after taking up city life. Similarly, the negro was considered immune before the abolition of slavery, but, since his transfer from plantation to city life, his race has furnished its proportion of persons affected. At present, in America, about 15–20 per cent. of the patients admitted to the mental hospitals suffer from paresis.

Sex.—Males appear to be affected more frequently than females. In recent years, on account of the increase in the number of female paretics among the negroes and among women generally of the lower class, the proportionate number of females has increased. In European countries it is estimated that there is one female affected to every three and a half males (Binswanger).

Age.—The majority of cases of paresis occur in individuals between the ages of thirty-five and forty-five years. Rarely does the disease begin before twenty-five or after sixty years of age. The average age has been lowered in recent years, compared with the time of Calmeil and Bayle, who found it chiefly at forty-five and fifty years. Juvenile cases are comparatively rare. According to Mickle, the disease is apt to occur earlier in the life of women than in men. There seems to be no doubt that paresis occurs most frequently in early adult life, the time when the nervous mechanism has attained its greatest development and also the period during which the demands upon the nervous system are apt to be greatest.

Heredity.—Compared with other forms of mental disease, heredity seems to play a small part. Paresis has been known to occur in parents and children, but in the light of recent findings such instances are the result of congenital syphilis. Bolton [3] analyzed eighty-five cases from the standpoint of heredity and found a neuropathic tendency manifested in several ways. True psychoses, epilepsy, psychopathy, intemperance, phthisis and an abnormally high death rate were found in the families investigated. Naecke,[4] who has estimated the influence of heredity at 43 per cent., remarks that the relative frequency of the stigmata of degeneration among the paretic patients places, next to syphilis, a certain very important etiological factor, not yet sufficiently understood, as a certain strongly marked constitutional weakening of the brain, which makes it more predisposed to the noxious effects of certain poisons.

Alcoholic and Other Excesses.—A history of alcoholic excess can be elicited in many instances; sometimes alcohol is erroneously given the credit of being the direct cause. Alcohol does appear in some in-

stances to be an important and effectual influence, but it cannot be considered the sole factor in any case.

The etiologic influence of the abuse of alcohol, practised for generations in France and Italy, has recently (and probably correctly) been thought responsible for the frequency of paresis in these countries; but the fact that paralysis is a very rare and even unknown disease in other countries where syphilis is common, but alcoholism rare, seems to indicate that alcoholism is a predisposing factor to paresis (Binswanger).

Individuals who have not been in the habit of indulging in alcohol to excess may do so as a result of lack of self-control, characteristic of progressive paresis, and often an early mental manifestation of the disorder. Sexual excess has also been looked upon as an important factor, but here again this is perhaps more often an early symptom and, when present, usually continues as a symptom before other signs of paresis are noticed.

Mental Stress and Overwork.—Paresis usually makes its appearance at the prime of life, the period when the physical and mental activity is at its maximum, when efforts to gain wealth, fame, power and position are greatest, and when greatest disappointments are apt to occur. Not infrequently a business calamity is the immediate forerunner of the first symptoms. This may be explained by the fact that protracted labor, mental or physical, carried on under the direction of a worried mind may act as an exciting factor. Mental stress, coupled with alcoholic excess, often sought as a temporary relief from worry, serves to intensify the influence of hard work as a causal factor.

Syphilis.—Whether syphilis produces paresis or not is a question that has furnished a subject of controversy for many years. In 1857 Esmarch and Jessen, and in 1863 Kjelberg expressed the opinion that syphilis is always the cause of general paresis. This statement was not regarded seriously by psychiatric authorities at that time, and consequently was little heeeded until brought into prominence in 1875 by Fournier. Since such authorities as Fournier and Moebius have stated that without syphilis there can be no paresis (Moebius regarded general paralysis as "cerebral tabes"), there has been much written both for and against syphilis as a causative agent. The arguments against syphilis as a causative factor are chiefly negative, inasmuch as they are based upon the fact that certain data are wanting to prove some apparently conclusive instances.[5] Naturally such data are accepted as negative evidence until they can be proved otherwise. The fact that a negative syphilitic history is obtained in about 20 per cent. of paretics is insufficient proof, for the reason that many syphilitics do not give a history of a primary lesion and may not have had the usual secondary physical signs. The long interval between the active syphilitic process and the appearance of the paretic manifestations is a reasonable argument against the luetic origin of the disease, but likewise is inadequate,

if we consider that antecedent syphilis may be a necessary factor if only to prepare a soil for the development of paresis. The absence of paresis in Africa, Turkey, India and other countries, where syphilis is common, has been answered by the fact that when first introduced into a country syphilis runs a rapidly fatal course, and by the fact that it is the apparently milder cases in which paresis is apt to occur. Furthermore, the absence of such influences as alcohol and stress of civilization, as well as race peculiarities (Kraepelin), should be taken into account.

It has been approximately estimated that probably only two to four per cent. of syphilitics develop paresis. It is also known that only from three to seven per cent. of syphilitics develop tertiary lesions. However, the number of paretics appears to be increasing; this is doubtless to be accounted for by the fact that the paresis is more often diagnosticated than formerly. That the disease does not as a rule respond to syphilitic treatment has been offered as evidence of the non-syphilitic character of paresis. The explanation of this is doubtless founded upon the organic basis of the disorder, which is characterized by a neuronic degeneration; and upon the fact that medication cannot bring about repair in tissues that have undergone such changes.

Finally, the fact that a positive Wassermann reaction may occur in some cases of scarlet fever, leprosy and sleeping sickness has been offered as opposed to the specifity of that test. The fact that practically 100 per cent. of paretics react positively is much more in favor of the luetic origin of paresis than the other facts are against it.

Among the arguments in favor of the syphilitic origin of paresis are the following strongly positive points: About 80 per cent. of general paralytics give a positive history of an antecedent lues or show physical signs. In cases in which both of these factors are absent the Wassermann reaction usually clears up the doubt. Patients suffering from paresis have never been known to contract chancre. Nine cases, reported by Krafft-Ebing, in which paretics were inoculated with syphilis resulted negatively. In the juvenile paresis a history of lues in parents is practically always obtained. Mott found, in sixty cases of juvenile paresis, evidence of congenital lues in the family history and the physical signs of syphilis in nearly every patient, and was not able to exclude syphilis in any instance. Other exciting causes, such as alcohol, sexual excess and mental stress, also could be excluded in these cases.[6] Two virgin sisters are recorded as victims of congenital syphilis, who died of paresis at the ages of forty-two and forty-three years. In both of these there were present stigmata of congenital syphilis, otherwise the cases might have passed for paresis without syphilis.[7] The following statement from such an authority as Régis, in the last edition of his text-book, is significant: *"De tous les arguments invoqués contre l'origine syphilitique de la paralysie générale, il n'en est qu'un seul, je crois, qui ait une réelle valeur."*

An important link in the chain of evidence has been added by the discovery of the **Treponema pallidum** * of syphilis by Schaudinn in 1896 and by the introduction of the Wassermann reaction and the finding that general paralytics give a positive reaction in practically every instance when the spinal fluid is subjected to the test. The spinal fluid reaction has been found to occur more frequently in paresis than in cases of gross syphilitic brain disease (Fig. 67).

Further evidence has been added in the discovery of treponemata in the brains of paretics, which seems to be the most important addition to the pathology of the disease. Noguchi and Moore [8] were able to demonstrate the organism in twelve brains out of seventy-two examined. The organisms were found in all layers of the cortex except the outer; but not in the vessel sheaths, and not in any relation to the

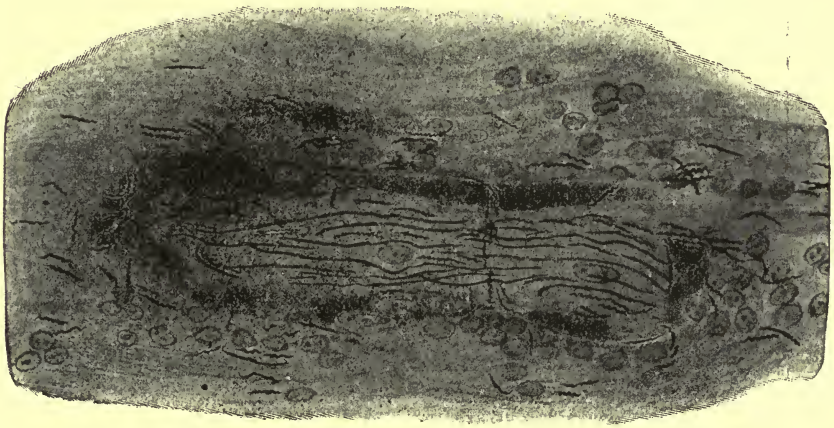


FIG. 67.—Treponema pallida. (*Ehrmann from Nonne.*)

blood-vessels or lymphatics. None were found in the pia. In all instances coarse cerebral syphilis could be excluded (Fig. 68).

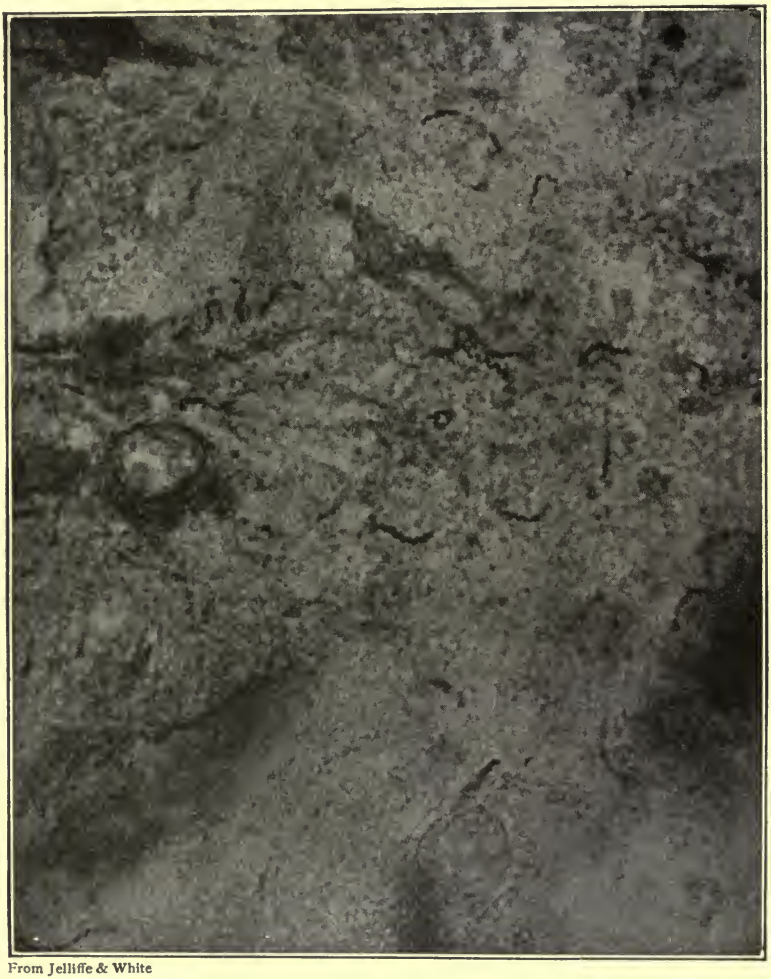
In a later series Noguchi was able to find thirty-six positive cases in 136 brains examined. Similar results were obtained by Marie, Levaditi and Bankowski. Head [10] and his coworkers [11] found the organisms practically always confined to the gray matter, report one instance in which the treponeme was found in the meninges.

Pathogenesis.—Although the belief that syphilis is in some way responsible for the occurrence of paresis is now generally accepted, and one phase of the problem seems to have been settled, the actual pathogenic process is still to be explained. Inasmuch as in most instances all of the clinical manifestations of syphilis have disappeared, and it is commonly a matter of years, usually from five to fifteen, between the time of infection and the appearance of the prodromal symp-

* Also frequently called *Spirochæta pallida.*

toms of the mental disorder, it would seem to be indicated that syphilis is not wholly responsible in the pathogenesis.

Several hypotheses have been offered to explain the development of paresis after the long period of inactivity of the treponemata.



From Jelliffe & White

FIG. 68.—Treponema pallidum in the cerebral cortex in paresis. (*Moore.*)

(1) The clinical manifestations of paralysis are an expression of the reaction and the necrosis of hypersensitized areas of the nervous system, evoked by the reappearance of the *spirochæta pallida* (Head).[12]

(2) The process is pathologically one of primary degenerative changes of the neuronic elements, and the infiltration process involving the neuroglia and blood-vessels is a secondary process the result of irritation produced by the primary changes (Mott). Mott and others

have suggested an especially virulent strain of organism ("neurotropic" "virus nerveux") which is attracted to the nervous system. To substantiate this are cited examples of conjugal paresis and the recorded instances in which several individuals known to have been infected from the same source developed paresis, as in the case of seven glassblowers who were infected, four out of five examined twelve years later developed tabes or paresis.

Sufficient proof has not been obtained to show that there is a special type of spirochæte having an affinity for the nervous system.

The positive Wassermann reaction in both the blood and cerebrospinal fluid in nearly all paretics and the positive blood serum reaction in brain syphilis with a negative reaction on the part of the cerebrospinal fluid point strongly towards a progressive character of the syphilitic element in paresis and the parenchymatous nature of the reaction.

Plaut,[13] in discussing the Wassermann reaction, states that he considers that "we are not going too far when we further accept that paretics at the time of onset are still syphilitics, and we hold these conclusions therefore as justified because paretics behave, in regard to the reaction of the serum, like patients in the florid state of syphilis and differ clearly from the latent tertiary syphilitics." When it comes to the matter of one of these two classes of sera reacting in a negative manner, it is more apt to be the serum of the florid syphilitic rather than that of the paretic. In contrast with active syphilis, however, we find the spinal fluid gives a positive reaction, while, in the florid stage and in later stages of syphilis, as has already been mentioned, the reaction is positive in the blood serum only. Upon this difference doubtless the pathogenesis of paresis may eventually be based. The exact nature of the reaction may possibly be determined when the explanation of the serum reaction is better understood from a biochemical standpoint, or when more precise methods of technic for the Wassermann test are discovered. Apart from the pathologic consideration of the process at work in the production of general paralysis, there are several clinical manifestations which strengthen the assumption of a toxic agent as largely responsible for the symptoms of the disease.

During the prodromal period of paresis the occurrence of fever, with or without mental symptoms, the so-called seizures so common in advanced paresis, which occur in the form of a sudden elevation of temperature with mental confusion, stupor or actual coma, or with epileptiform convulsions, transient aphasia, hemiplegia, or general muscular weakness, all point towards an inability on the part of the cerebral substance to normally eliminate toxic materials, and these, reaching a point of accumulation beyond the resistance of the neurones, precipitate an attack.

Pathological Anatomy.—The earlier view that paresis is a chronic encephalitis has given way to the doctrine that the disease fundamen-

tally depends upon a neuronic degeneration and that the chronic "inflammatory" changes are secondary in the neuroglia, blood-vessels and meninges. Mott [14] takes the view "that in certain acquired or congenital syphilitic individuals the durability of the neurones is curtailed so that they die prematurely, thereby giving rise to a series of symptoms which may be associated either with irritation of definite nerve structures or with neural destruction." Dunlap [15] believes that there is a point at which pathologically it is difficult, if not impossible, to distinguish paresis from true cerebral lues. He regarded the two pathological processes as "usually distinct varieties of the same general process."

The pathological process in the cortex gives rise to a picture which in its details varies with the phase of the disorder studied. In general the changes may be said to be essentially indicative of the chronic nature of the malady. These are manifested by an inflammatory-degenerative process with a chronic interstitial reaction in the tissues involved.

Although it has been demonstrated in paresis that syphilis is at the base of lesions of the nervous system, it may be said at the outstart that in a general sense the lesions are not the ordinary syphilitic lesions seen in the gummatous, meningitic and vascular types of infiltration. True, gross cerebral syphilis is primarily an invasion of the mesoblastic or connective tissue elements, which results in a proliferation of these structures, producing changes that are characteristically "interstitial" in type.

In paresis, on the other hand, the invasion seems to be primarily parenchymatous, involving the neuronic elements. The interstitial changes probably are secondary, although it is possible that the two "sets" of changes may proceed simultaneously with varying degrees of intensity in different parts of the nervous system and in different regions in the cerebral cortex, but at first chiefly involves the parenchymatous structures.

Gross syphilis of the nervous system is marked by more or less sudden and clear involvement of the meninges, cortex, nuclei or nerves of the cranial distribution; while in paresis the disorder is usually insidious in onset and without clinical evidence of gross focal lesion.

Head [12] found in early cases that the lesions are "relatively simple." The pia is inflamed, thickened and abnormally adherent to the cortex. There is also an infiltration of the pia by many lymphocytes and plasma cells, but the fixed elements, that is, the endothelium of the small blood-vessels, show but slight proliferation. The cortical vessels show both proliferation and cellular infiltration. The ganglion cells are swollen, chromatolytic and degenerated; the neuroglia cells are increased in number and in some places closely arranged. The nerve cells and neuroglia involvement Head regards as analogous to the tertiary lesions of syphilis of other organs, in which the parenchymatous lesion is more

marked than the interstitial lesion. The reaction has consequently been termed "tertiary syphilitic parenchymatous encephalitis," and is explained on the ground that developmentally and anatomically the parenchymatous nerve tissue (nerve-cells and neuroglia) is separated from the interstitial tissue by the limiting membrane which lies between the outer zone of the cortex and the innermost layer of the pia. There is thus formed an impenetrable barrier beyond which the spirochætes cannot pass from the meninges into the cortex and *vice versa.* Head and his associates regarded the reaction on the part of the tissue as the result of an excess of syphilitic virus in the brain substance giving rise to a reaction on the part of the nerve-cells, equivalent to the "cloudy swelling" of the parenchyma of other organs, and also to a proliferation of the neuroglia which is analogous to the proliferation of the fixed connective tissue cells in other parts of the body.

There is an attempt on the part of the lymphocytes and plasma cells in the lymphatics of the meninges to reach the spot invaded by the spirochætes, but, due to the presence of the above-mentioned barrier, this is anatomically impossible, hence gummatous reactions do not follow. The extent of the meningeal involvement varies with the length of time the disease has existed.

The route by which the treponemes gain entrance to the parenchyma of the nervous structures has not been definitely determined Levaditi [16] and Ehrmann [17] have shown that the organisms may travel from the site of an initial luetic lesion along the peripheral nerves. Spirochætes were found in the lymph-spaces of the perineurium and between the nerve fibres.

Orr and Rows [18] have shown that the perineural lymph-sheaths of the spinal roots and nerves acts as afferent channels to the central nervous system and connect with the lymph-spaces of the pia and the blood-vessels which penetrate the nerve tissue.

The question of the location of the spirochæta between the period of infection and active somatic syphilitic lesions and the appearance of nervous symptoms is as yet unanswered. From all appearances it must be said that the spirochætes are for the time inactive, and that the inactivity is due to either increased resistance on the part of the nervous tissue or to a diminished virulence on the part of the organism, or, perhaps, to the naturally unfavorable soil which the brain tissue offers for the development of the parasite.

Mott suggests that the treponemes may have renewed their activity after having for years remained in an inactive state in the tissue, possibly in an intracellular granule form.

Gross Pathological Changes.—The cranium often shows anomalies and irregularities of the bony structure. Exostoses and hyperostoses are common in paretics, but can hardly be considered as characteristic of the pathologic process, since these also occur in subjects who are not paretics. Either thickening or rarification of the bone

with a corresponding increase or diminution of the diploe is frequently observed.

The membranes usually are the seat of chronic inflammatory changes, not uncommonly accompanied by hemorrhage, **pachymeningitis interna,** hematoma and even actual hemorrhagic extravasations into the pia-arachnoid. The pia-arachnoid may show thickening, especially along the course of large vessels, while in other localities, such as the frontoparietal region and the interpeduncular space, the pia appears clouded, opaque and hyalinized. The veins appear larger in calibre than normal and their walls thickened. The large arteries, although commonly fibrotic, are remarkably free from atheroma. The pacchionian bodies are often hypertrophied, and, as is usually the case, produce deep depressions on the inner surface of the calvarium.

The cerebrum shows but little gross change early in the course of paresis. As the disease advances, the entire brain mass is diminished from 20–25 per cent. (Tanzi). The gyri are individually atrophied. some more than others. Usually these are more or less flattened and shrunken, while the sulci are correspondingly widened. In areas in which the atrophy has been greatest there is usually an increase in the cerebrospinal fluid which may be localized by adhesions between the pia-arachnoid and the cortex. In advanced cases firm adhesions are formed between the pia-arachnoid and the surface of the cortex, particularly at the summits of the convolutions. The adhesion is at times so firm that an attempt to strip the membrane from the cortex results in a laceration of the brain substance just as happens in stripping the capsule from a contracted kidney.

In gross sections of the cerebral hemispheres the width of the cortex can be seen with the naked eye to be greatly reduced, particularly in the convolutions which show the greatest atrophy. True focal lesions, other than atrophy and thickening of the membranes, are not seen as a rule, although occasionally areas of softening and hemorrhage are found.

Ependymal changes are found in the majority of cases. The ventricular lining is usually studded with minute granulations due to proliferation of the neuroglia. These granulations are coarse and of fair size so that they may be detected easily with the unaided eye.

Microscopic Anatomy.—In advanced cases the microscopic changes in the central nervous system are characteristic in the paretic brain. They may be considered as (1) the ganglion cell changes, (2) those of the nerve fibres and (3) those of the neuroglia, blood-vessels and meninges.

Cellular Changes.—The protoplasmic processes of the nerve-cells are found in various stages of destruction. The intracellular fibrils may be preserved in parts of the cell, while usually in the centre of the cell body and at the margins the degenerative process may be far advanced, shown by the breaking up of the fibrillæ as the result of sticking

together or fusion of several fibrils; others appear as short, heavy broken pieces, while the rest of the fibrils have become distintegrated into granular *débris*. By staining with the method of Nissl, or one of its various modifications, distinct cellular changes are recognizable, although not especially characteristic of the paretic brain, except in that the cell processes give the appearance of having "rotted off" as the result of the severity of the destructive process. Under low magnification the ganglion cells appear plainly reduced in number and the characteristic lamination of the nerve-cells is markedly disordered. The outlines of the individual cells are often altered to the extent that the cells appear deformed; their angles are either rounded or blunted; the nucleus, often abnormally deeply stained, is swollen, extending to the borders of the cell-body. The cytosome is actually reduced in amount and the Nissl granules absent or distributed in powdery clumps at the base or at the margins of the cell. In many of the larger pyramidal cells the brown or yellow pigment, normally present in small amounts, is increased, especially at the base of the cell.

Marked degenerative changes in the neuronic elements are the typical ganglion cell alterations, consisting of disarrangement of the lamination and disalignment of position of the individual cortical cells. In addition to these destructive changes, there is an infiltration of elongated "stabschen cells," which, according to Alzheimer,[19] are the nuclei of connective tissue-cells proliferated from the adventitia of the blood-vessels, and are therefore of mesodermic origin. There is also a rich overgrowth of neuroglia, an infiltration of the meninges, and the perivascular spaces contain plasma cells which probably originate from the blood.

Nerve-Fibre Changes.—The most marked and at the same time the most constant of the early cortical changes involve the tangential fibres shown by the loss of the myelin sheaths and atrophy or entire disappearance of the nerve-fibres. The degenerative process affects also some of the fibres of the projection and association paths, but not to the extent of involving large groups of fibres in any pathway. Sections of cortex stained by the Weigert myelin sheath stain, or one of its modifications, show that the degenerative process is not at all uniformly distributed, but that the degree of fibre atrophy is greatest in those regions in which the intensity of the degenerative process is greatest, namely in the region containing the corresponding nerve-cells.

Neuroglia.—The reaction in the neuroglia is one of proliferation. Although histologically a supporting structure, developmentally the neuroglia is of epiblastic origin and therefore its changes have recently been regarded as part of the parenchymatous reaction to the syphilitic virus, in contradistinction to the reaction of the mesoblastic elements as occurs in the meningeal and vascular types of nervous syphilis.

In paresis the reaction on the part of the nerve-cells is primarily degenerative or inflammatory, analogous to cloudy swelling of the cells

of other organs, while the reaction of the neuroglia is proliferative. The number of neuroglia cells is increased, more so in some localities than in others. The proliferation is most marked in the molecular layer of the cortex, some of the newly formed cells reaching large proportions. Astrocytes are often found abundantly in the white matter, where normally they are absent. In the cerebellum the Purkinje cells have been found to be surrounded by proliferated glia cells. The ependymal granulations belong strictly to the neurogliar changes, since the former are produced by discrete accumulations of glia cells in the ventricular lining membrane, producing the so-called **granular ependymitis.**

The astrocytes with their glia fibres are to be found wherever there has been the greatest nerve-cell destruction, and also in the vicinity of the smaller blood-vessels. As the result of the increase in glia fibres there are shrinkage and narrowing of the cortex after the manner of the formation of cicatrices in other tissue. Later the neuroglia cells undergo degenerative changes and finally some of them disappear after having produced glia fibres. Some of the glia cell changes are described by Bevan Lewis and Alzheimer as possessing amœboid characteristics, including that of phagocytic activity ("neurophagic") by which degenerating ganglion cell detritus is removed.

The end result of the pathologic process is the destruction of the ganglion cells and the filling in of the gaps thus made by proliferation of the neuroglia and the formation of fibrillar substances at the expense of the neuroglia cell.

The destructive process and the inflammatory process appear to go side by side, particularly that part of the process which implicates the vascular structures.

Alzheimer regards the histological picture in most instances as sufficiently characteristic for the establishment of the diagnosis from the appearance of brain sections alone, and almost without exception the lesions are so constant that the diagnosis can be made with certainty, if the clinical data are taken into account.

Blood-vessels.—The cortical vessels are the seat of marked changes, also proliferative in character. Their adventitial sheaths are invaded by lymphocytes and plasma cells; the endothelial lining is but slightly involved, but the connective tissue in the vessel walls is hyperplastic. True obliterating endarteritis is not found early in the disease. There is an increase in the number of vessels, especially capillaries. In advanced cases the small blood-vessels are easily located in the section by collections of deep staining cells which envelop the vessel walls. These cells are the lymphocytes, plasma cells and other migratory elements.

For a time the plasma cells which invade the adventitial sheaths of the cortical vessels were regarded as constant in paresis and not present in other chronic diseases. Nissl, who formerly was of this

opinion, now regards the changes in the paretic cortex as also occurring in other forms of cerebral disease.

It is only by means of the entire pathological picture, which indicates the wide distribution of the pathologic process, the greater involvement of the frontal region of the cerebrum, the widespread new vessel formation and marked destruction of both nerve-cells and nerve-fibres, and the invasion of the vessel sheaths by plasma cells and lymphocytes, that the diagnosis can be certainly established microscopically.

Cerebellar Changes.—The most constant changes in the cerebellum are those in the meninges, and are chiefly characterized by cellular infiltration and, in some areas, by destruction of the Purkinje cells. The presence of multinucleated Purkinje cells has been described by several investigators in the cerebellum in cases of juvenile paresis. This is regarded as an evidence of developmental defect rather than an indication of the syphilitic affection of the nervous structures, inasmuch as double and triple nucleated cells have been found in dementia præcox and organic brain disease regarded as non-syphilitic.

Spinal Cord and Peripheral Nerves.—In cases of long duration, spinal cord changes are practically always present and may exist either in the form of diffuse lesions or may occur as **system** degenerations (Fig. 69).

The diffuse lesions involve the cellular elements and are characterized by the same type of change found in the cortical cells, marked by atrophy, excess of pigment and chromatolytic changes. The neuroglia substance shows a hyperplasia, and the nerve-fibres in the gray substance are degenerated in consequence of the nerve-cell destruction. The pia mater and blood-vessels are the seat of chronic inflammatory changes which show its effect upon the adjacent marginal white fibres by a diminution in their number and an overgrowth of neuroglia.

Of the systemic lesions the most frequent is that which involves the posterior columns as in **tabes dorsalis,** constituting the so-called tabetic type of paresis. Involvement of the pyramidal tracts throughout their course is not pronounced as a rule, although, not infrequently, marked diminution in the number and size of the fibres at certain levels of the cord may be seen, due to the involvement of the corresponding cortical neurones. Combined system changes which include the posterior and lateral columns (Gower's, and direct cerebellar tracts) are often the result of a diffuse involvement of the cord at one level, with subsequent ascending and descending degenerations.

To summarize, the pathological diagnosis of paresis rests upon the findings of a diffuse parenchymatous syphilis of the cerebral substance, characterized microscopically by a loss of the tangential fibres of the cortex, disorganization of the cortical cell lamination, overgrowth of neuroglia, infiltration of the sheaths of the small blood-vessels with plasma cells and lymphoid cells and by an invasion of the cortex by the *treponema pallidum.* The exudative material is confined to the

vessel sheaths. The microscopical diagnosis is to be based upon the characteristics in their totality rather than upon any single characteristic pathological alteration.

Symptoms.—The symptoms of paresis, as already indicated, are both mental and physical. The essential symptom is *enfeeblement* of mind and of body. In most instances this is a very slowly developing symptom-complex, but invariably progresses with mental and physical deterioration, ultimately terminating in death from exhaustion. The mental weakness progresses until there is no capacity for thought. Physically the conspicuous symptoms are motor weakness and incoördination, which progresses until a state of total helplessness is reached, a "general paralysis," on the basis of which the term "dementia paralytica" is applied.

Usually the mental symptoms precede the physical signs, or at least are the first to attract attention. In fact, unless looked for very care-

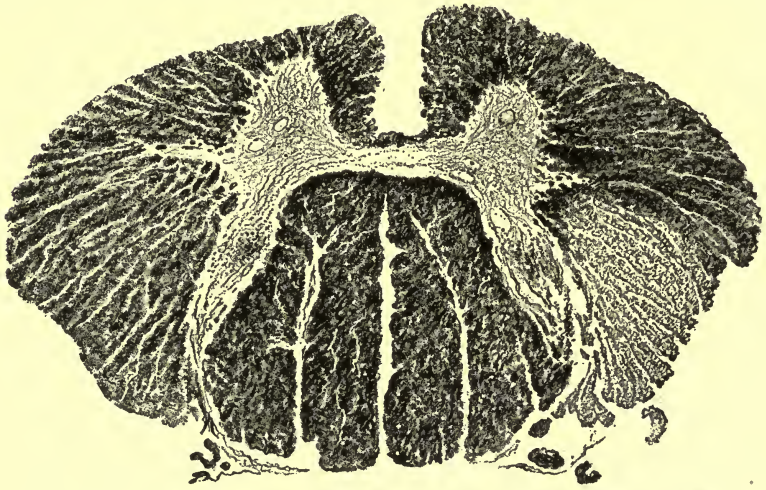


FIG. 69.—Unilateral descending degeneration in spinal cord in a case of paresis.

fully, the physical symptoms may be overlooked. When the disease is well advanced the diagnosis is made with comparative ease in the average instance, although in different individuals the mental symptoms and physical signs show considerable variation in intensity. They may disappear for a time, but are sure to return. Clouston reported a remarkable case in which two remissions occurred, one of fifteen years' and the second of seven years' duration, the patient remaining alive for two years after the second remission of symptoms.[7] Instances of remissions lasting for several months are common. A few cases have been recorded in which the symptoms have abated while the patient lived for many years and died of an intercurrent affection without the reappearance of the paretic symptoms, although the autopsy revealed the typical anatomical changes of paresis.

Prodromal Phase.—In the prodromal stage the symptoms may be such as to excite attention, but, commonly, they do not at once suggest mental disease to the lay observer.

The business man makes extravagant speculations or buys for his stock beyond the normal expectation of the demand of his trade; the merchant is inaccurate in making change in his sales; the bookkeeper's accounts show frequent errors; the man of a family makes indecent proposals to women of the neighborhood. The housewife neglects her home and children without adequate excuse, makes social engagements only to forget them, makes many needless purchases for personal and household use. These and similar evidences of defect of judgment often continue for months before marked mental disorder is noted. After a time there appears a decided mental change in the form of dulness, somnolence, confusion, depression or excitement, or a state of nervous exhaustion resembling that of the ordinary neurasthenia. When the patient exhibits a state of dulness, it is characterized by mental inactivity, loss of interest and somnolence. He sits about all day, seldom speaks and frequently dozes; he may fall asleep at table during meals.

Periods of mental dulness are often broken by irritability or even outbursts of anger, provoked by trifling causes.

In the early period of the disease the mental impairment is chiefly shown by weakness of the judgment and the dulling of the higher sensibilities. The change is one of character, habit of thought and action, and alteration of the finer feelings of the individual. This, together with a loss of self-control in regard to trifling matters and with occasional though serious memory lapses, often constitutes the characteristic early mental symptoms. In this stage of the disease the patient is usually able to continue his business and to retain customary social relations in his community, so that commonly it is not until he has made some business blunder or palpable infraction of the civil code that it is realized that something serious has happened.

During the prodromal stage there are significant **memory lapses**, which are accountable for many of the inconsistencies of conduct and the change in attitude towards matters which normally held his interest.

Certain physical signs may be present at this time. Facial tremors, especially during mental excitation, alteration of the deep reflexes, and even pupillary changes may be marked, but are usually not clearly established until the second stage of the disease.

The symptoms of paresis may, for convenience, be considered as those of the period of the development of the disease, those of the well-established disorder, including the period of decline.

The Developmental Period.—The prodromes of paresis usually extend over many months and not infrequently several years. As previously indicated, the patient usually exhibits changes in his habit of thought and action, which at first, because they may only be mani-

fested occasionally, are not uncommonly overlooked. These changes are the expression of an *altered emotional state* and may be indicated by indifference, exaltation or depression, with a strong tendency to variability in mood and with rapid change from one affective state to another.

Not infrequently the prodromal symptoms are sufficiently similar to those of neurasthenia that the differentiation is sometimes made with difficulty in the absence of characteristic physical signs. The most prominent of these symptoms are general muscular weakness and a feeling of fatigue, with diminished capacity for mental or physical work, fleeting and indefinitely localized neuralgic pains, headache, anorexia and insomnia.

Unlike the true neurasthenic, the paretic may be easily diverted from his physical discomfort if his attention and interest can be held to other topics. During this period the patient may be profoundly depressed, introspective, hypochondriacal and speak despondently as to the outlook in regard to the matter of his cure, fearing that he may be suffering from some serious malady, but not suspecting its real nature.

Occasionally during the prodromal period there are episodal attacks which reveal the serious character of the disorder; these appear in the form of transitory periods of unconsciousness, mild convulsive seizures, with or without apparent loss of consciousness, transitory local palsies of the face or ocular muscles, diplopia, brief periods of loss of speech or aphasia. Rarely the first observed symptom is an apoplectiform or epileptiform seizure with a partial hemiplegia lasting a few hours or a few days.

Not uncommonly the above mentioned neurasthenic symptoms disappear, much to the patient's joy and self-assurance that he has been restored to health. It is at this juncture that a state of *mental exaltation* appears which is beyond that of the patient's normal emotional trend. He now becomes more active than ever in matters connected with business and social affairs. He makes extravagant plans for business investments or for domestic affairs without regard for proportion or serious consequences which the carrying of these plans into effect would entail. His insomnia continues, but now it is the sleeplessness which accompanies mental exhilaration; he feels that he has not time to sleep, that he can accomplish more work than ever before, and consequently exhibits a markedly increased psychomotor activity.

He may sit up all night writing letters describing his impossible projects to disinterested persons. His speech is rapid, his manner indicating an entire disregard for the judgment or opinions of anyone who may attempt to advise him. At such times he may show a marked tendency to irritability and often is provoked to anger by the mere expression of an opposing idea.

During and following such outbursts there may be noticed slight

alterations in speech, such as the omission of syllables or their misplacement in the words uttered. When angered, the patient is often abusive and may resort to physical violence. Usually the fits of anger are soon over and subside without any apparent sense of realization of what has happened.

The more serious alterations of the patient's mental make-up are shown by his altered *moral sense* and disregard for the common conventionalities of life. His lack of thought for the comfort of others is conspicuous; coarse and even obscene language, entirely foreign to the patient's habit in his normal state, may be given utterance irrespective of persons in his presence.

Flagrant moral lapses and criminal offences may be committed with utter disregard of their impropriety or gravity.

A patient seeing a check lying on a shop-counter appropriated the same and, as further indication of his enfeebled judgment, attempted to deposit the check in his own bank after endorsing the check with the name of the payee.

In general it may be said that in this phase of the disorder the reactions are largely impulsive in character and therefore without regard for consequential possibilities, due to the lack of judgment arising from the enfeeblement of the intellectual processes and the loss of the normal inhibitory control over volitional and instinctive impulses. Not uncommonly the patient is credited with acting under the influence of alcoholic intoxication on account of the transitory character of the early mental symptoms.

Some patients exhibit lack of self-control in the form of excessive alcoholic indulgence, in which instances the alcohol may be credited with being the causal factor in the mental disorder, as already noted.

Among the lower classes especially, the incipient paretic frequently is arrested upon the charge of drunkenness, theft or an attack of violence.

Stage of Decline.—Although no line of demarcation can be distinguished between the last two stages of the disease, when the symptoms of the one are compared with those of the other stage, it is easily recognized that the third stage is the period of decline and that it is marked by mental and physical failure from which there are no remissions. This period, which is the terminal phase of the disease, may extend over many months, or even several years after the patient has become bedridden.

The physical signs are now more pronounced. The most conspicuous are the motor disturbances which are dependent upon muscular weakness and defective innervation. The tremors are now coarse and irregular. During attempts at speech most of the muscle groups of the facial distribution are tremulous, giving an appearance as if nearly all of the facial muscles were brought into play in an effort to coördinate the movements of the speech mechanism. Not only are

there tremors of the orbiculars of the lips, as is seen earlier in the course of the disorder, but also the depressors of the mouth, the zygomatic, palpebral and the corrugators and frontalis muscles are brought into play. Speech is now more difficult and is drawling, tremulous and slurring to the point of being almost unintelligible, and at times so difficult as to give rise to sputtering and explosive utterances. Finally the speech is reduced to a few monosyllables or it may be entirely absent.

Tremors of the large muscle groups are likewise more pronounced and the bodily movement incoördinate. The gait becomes ataxic, so that the patient totters and sometimes falls. The marked disturbance of gait and general weakness are usually sufficient cause for the patient being kept in bed to insure safety from injury.

After the patient has been confined to bed for a number of weeks contractures occur as the result of the overaction of the stronger flexor groups of muscles, especially in the lower extremities. The contractures may involve all four extremities, and not uncommonly affect also the muscles of the neck, so that by the overaction of the sternomastoids the head is kept in a raised position, so that it does not come in contact with the pillow.

The sphincters at this stage of the disease are involved, so that there is incontinence of both urine and feces. Distension of the bladder may occur, due to urinary retention, which might be easily overlooked, unless daily attention is given to the amount of urine voided, for the reason that the patient frequently experiences no discomfort from this source on account of the loss of sensibility. Occasionally one meets with an overflow of retention, when, in spite of voiding many ounces of urine daily, the bladder may become greatly distended and in danger of rupture.

The terminal paretic commonly grinds his teeth all day long. Swallowing is difficult, making it necessary to limit the diet to liquid and soft foods which must be administered slowly in order to prevent the patient from choking.

The characteristic paretic "seizures" become more frequent in the terminal phase of the disorder; following each convulsion the patient grows weaker and more helpless. There is at this time rapid wasting, which is generalized. Unless the greatest care is exercised in the attention to the skin, bed sores will develop wherever there is pressure upon the tissues overlying bony prominences.

There is usually an irregular rise of body temperature with exacerbations corresponding to the occurrence of the seizures. The temperature may remain subnormal.

In this condition the patient may continue a purely vegetative existence for months until he dies of some intercurrent infection with bronchopneumonia, or as the result of inanition and exhaustion.

Mentally there is a gradual failure with ultimate total loss of function indicated by the fact that the patient's capacity for thought is prac-

tically nil. He is no longer able to comprehend what is said to him and cannot answer the simplest questions. The mental dulness has by this time clouded all the patient's former delusive ideas, although occasionally one may notice remnants of the one-time euphoria, provided his speech attempts can be understood. He soon becomes more stuporous and pays little attention to his surroundings, lies muttering and fumbling with the bed-clothing, and at times gives vent to loud inarticulate sounds.

Like a decerebrate animal, he may exhibit the fundamental reactions of emotional expression when interfered with, as in giving attention to his physical needs; he may groan or snarl or squeal when disturbed. The reactions which are retained the longest are those connected with taking food, which he gulps rapidly as each spoonful is fed to him.

Mental Status

The mental status of the paretic is characterized by dementia, which is present in some degree from the very beginning of the disorder. Involving only the more complex mental processes at first, the dementing process progresses and sooner or later involves all the mental functions. The order in which the mental processes become affected is not fixed, and therefore the mental picture varies considerably in different individuals.

Perceptive Processes.—Perception is not fundamentally disordered seriously from the standpoint of sense falsification except there be some complicating toxic state or organic disease of a sense-organ. Hallucinations have been reported to occur in paresis, but in the writer's experience the symptoms, when present, have been the outcome of an accompanying exogenous intoxication, particularly when complicated with alcoholism. Partial deafness, which often occurs in paresis, may give rise to auditory sense falsification in the form of illusion, as is true of any form of mental disorder. The same may be said of the cases with optic atrophy. The majority of observers seem to agree that true hallucinations are rare and when present play but little if any part in the development of the mental disorder.

Illusions are much more frequent and are the result of the intellectual defect. On account of the inaccessibility of patients who present evidence of such sensory disturbance, it is difficult to determine whether the illusory mental products are the result of the fundamental enfeeblement of mind or whether they are due to an organic sensory disturbance in the form of paræsthesia.

Except in cases in which the neuropathic predisposition (*predisposition vesanique*) is marked, or in which a toxic state exists, hallucinations are not very frequent, nor do they occur with the persistence with which they occur in other psychoses (Regis).

Consciousness and Attention.—In the strict usage of the term, consciousness may be said not to be "clouded" except for comparatively brief periods following the transitory apoplectiform seizures

which may occur at any time during the course of the disorder. Apart from these attacks and the memory lapses, consciousness is for the most part clear, and environmental impressions are correctly apprehended, especially in the early phase of the disorder.

As the mental impairment increases, there is some evidence of imperfect grasp of percepts in their totality, and consequently facts of environment are not clearly apprehended. Frequently the fact that the train of thought is absorbed by a single idea serves to prevent gaining the patient's attention, on which account impressions are either not at all or are only imperfectly perceived.

In depressed states the attention is aroused and is held with difficulty. This may be due to mental torpor or to an increased susceptibility to fatigue. In excited cases the rapidity of the flow of ideas precludes the possibility of gaining and holding the attention for more than a few moments, when a new stimulus is applied.

In some instances it is impossible, at certain times, to divert the attention of the patient, who seems bent upon carrying out his purpose in spite of opposing stimuli. It is under such conditions that persons who attempt to interfere with the patient's actions are exposed to the danger of a serious assault. In these instances there is often a temporary clouding of consciousness during which acts are carried out concerning which the patient has no recollection after they have occurred.

Emotional Tone.—Some alteration of the affective state is invariably present. This may be indicated by emotional indifference, exaltation or depression. Many cases which belong to the class known as the "simple demented type" of paresis furnish examples of affective indifference.

These patients lose interest in business, family and surroundings; they are mentally dull, apathetic or somnolent. Important events pass unheeded by them, and even serious situations may arise without arousing any feeling of concern. The mental apathy increases with the advancement of the mental enfeeblement. Such patients usually sit about idly all day, rarely speaking unless addressed. Occasionally they may be aroused by a suddenly occurring spontaneous idea. Thus a patient who has spent the greater part of a day in inactivity decides that he is "going out to get a cigar." An attempt to dissuade him is met by an outburst of temper and perhaps momentary violence. It is characteristic of the paretic to become very susceptible to emotional agitation, even in states of mental dulness. Almost as marked as the ease with which these patients are provoked to anger is the ease with which they may be diverted and calmed.

In the expansive or exalted states emotional irritability is more marked, perhaps on account of the excessive motor activity, coupled with gross defects of judgment, which so often lead to actions which require interference.

Train of Thought.—Depending upon the emotional status of the

patient will the train of thought be characterized by sluggishness of the formation of ideas, which is pronounced in the demented type of paresis.

Frequently, as in the exalted type, there is a rapid flow of ideas with marked volubility. Commonly these patients talk to themselves in a low conversational tone, expressing the same idea repeatedly.

The exaggerated feeling of well-being gives rise to euphoristic and grandiose ideas, out of which the delusive content is constructed. Although the number of ideas actually expressed may be numerous, the material out of which they are constructed is nearly always the same, so that there is a real impoverishment of ideas due to the early intellectual defect. Usually the thought content becomes so limited as to embrace but a single idea which is given expression in response to all stimuli.

One patient sat in a chair the entire day watching for the hands of the clock to point to seven, the time for his going to bed. Anyone stopping to talk to him would be sufficient stimulus for the patient to point to the clock and say, "Look, going to bed." Another patient would stand looking at her image in the mirror and say, "I am a fine cook."

Another patient's expressed idea was never more than "I am going to start next Thursday."

In the terminal phases of the disorder the capacity of thought appears to be reduced to nil. The reactions become reduced to the primitive type and are without expression except in purely motor reactions.

Memory.—From the beginning there is usually some indication of involvement of memory processes. Remote events are often recalled without difficulty but often inaccurately. Recent events, especially those falling within the period of the patient's illness, cannot be recalled on account of the impairment of impressibility. Occasionally retentiveness will be found to be remarkably good for some events, while others are completely forgotten.

On the whole, the amnesia becomes marked on account of the increasing loss of impressibility and retentiveness. The memory failure progresses rapidly, and ultimately the stock of memories becomes greatly reduced and impressions are of but momentary duration, with the possible exception of one or more ideas.

Falsification of memory is not uncommon. A patient may speak of a journey he has taken overnight, without regard for time and distance, or he may speak of having received visits from relatives or other persons or of having accomplished some impossible act.

Disorientation is common and depends both upon memory defect and the disordered judgment. A patient for several weeks believed that he was on a ship at sea.

In the hypochondriacal types the patient's thoughts are self-centred, and in some respects resemble the reactions of the depressed phase

of the functional psychoses, but differ chiefly in that they are usually beyond the realm of possibility and in this respect betray the profound defect of judgment.

Judgment.—As previously stated, the patient may realize that he is ill, and may express a good deal of concern about his condition. Patients often confess that they have been a "little nervous," but are "all right now." One patient stated that he was afraid he would get "paresis," and if not allowed to go home would "go to pieces." Real insight into the condition is entirely lacking. Defective judgment constitutes a fundamental defect in the paretic, on which basis arise his numerous expansive ideas and his unconventional conduct.

Delusion formation appears to be the outcome of the emotional tone and the judgment defect. In the exalted cases the delusions are characterized by their grandiose content. The patient dominated by the euphoria expresses his feelings in terms of adequacy beyond the realm of possibility. The ideas as a rule refer to self (autopsychic and somatopsychic), and are expressed in terms of wealth, bodily strength, personal accomplishments or ability. These ideas may include other persons (allopsychic), but in reality the ideas can be shown to be but a further elaboration of the original autopsychic delusion. Thus a teacher of music believes that he is the greatest musician in the world, and that his wife, who is the most beautiful woman in the world, is also the greatest singer.

The impossible character of the delusions of the paretic and their ludicrous content are one of the common characteristics. A patient lies quietly in bed all day without speaking, unless questioned, when he says he is going to have an operation performed to remove the millions of dollars that are in his body. Another patient says that he has come to the hospital to get his teeth fixed and is going to have diamond teeth put in place of the old ones. Another patient is the possessor of "golden houses" and "diamond automobiles." He is in the hospital "for a rest" on account of "nervousness" and is making money out of real estate while there and does not have to work. Another patient boasts of his physical strength; he has two hearts; by merely rubbing his hands together he is "making millions of money."

Depressive ideas are not infrequent. The patient may consider himself desperately ill, suffering from a number of severe diseases. One patient believed that his body was gradually growing smaller and thought that he was reduced to the size of an infant.

Although the delusive ideas may be depressive in content, they are, nevertheless, quantitatively grandiose. They are marked, like the euphoristic ideas, by their impossible character. He believes that he is suffering from an illness never before heard of and which will cause his death that very day; he has no organs in his body; he is solid as a stone and cannot breathe or he may even say that he is dead.

Occasionally self-accusatory delusions are met and are likewise

of impossible character. One patient persisted in the idea that he had destroyed the hospital in which he was a patient. More rarely there is an alternation between ideas of grandeur and those of belittlement. Thus, a patient presenting an hypochondriacal trend said that he was losing his eyesight, becoming deaf and dumb, losing the power to swallow and suffering pain from the crown of his head to the soles of the feet; on another occasion, greatly exalted, he had trillions of money and was in perfect health.

Delusions of a persecutory character belong rather to the earlier phase of the disorder and fade with the increased mental enfeeblement. Occasionally one meets with cases presenting a fairly well-marked paranoid trend.

Physical Signs

In the early phase of the disorder, especially, the diagnosis of general paresis cannot be made on a basis of mental symptoms alone. The early mental symptoms commonly are such as occur in other forms of nervous disease or disorder, as arteriosclerosis, senility, alcoholic and other toxic psychoses, epilepsy, manic-depressive psychoses and imbecility.

Mental change characterizing on the whole intellectual enfeeblement, together with certain definite physical signs and laboratory findings, are, however, pathognomic.

The physical signs which are the most important guides in the diagnosis are: (1) Pupillary changes, (2) muscular tremors, (3) disturbance of speech, (4) disturbance of writing, (5) general motility disorders, (6) alteration of the reflexes, (7) sensory disorders, (8) general somatic disturbances, (9) vasomotor and trophic disorders.

Pupillary Signs.—Some alteration of the pupil is more often present than absent. This may exist as inequality, irregularity of outline, or bilateral dilatation or contraction of the pupils. The iris reaction is often impaired with or without any of the other pupillary phenomena being present. In not a few instances the pupils may remain apparently normal until late in the disease.

The Argyll-Robertson Phenomenon.—The most constant ocular sign in paresis, although not confined to that disease, involves the pupillary light reflex. When typical there is complete loss of response to light stimulation in both eyes, with preservation of the convergence and accommodative pupillary contraction. Occasionally, as when the pupils are unequal, the failure of the light reflex may exist in the dilated pupil. Sluggishness of the light reflex is commonly present when the typical **Argyll-Robertson** reaction is not present.

Pupillary disturbances may appear and disappear; this fact has furnished a basis for the assumption that the symptom is not always due to degenerative changes in the neurons involved but may be due to the effects of toxins upon the neurons.

The loss of the pupillary light reflex, which occurs also in *tabes dorsalis,* is usually explained upon the basis of lesions situated anywhere in the intricate arc of the so-called ciliospinal reflex. The reflex arc has for its sensory (afferent) path the retina and optic nerve as far as the external geniculate body; the motor (efferent) path passes by way of the motor-oculi nerve and ciliary ganglion to the pupillary sphincter. When these paths are intact, the loss of the reflex is regarded as due to a lesion in the ciliospinal pathway.

The centre for the reflex is contained in the group of neurons extending from the lower cervical segments of the spinal cord to the first and second thoracic segments, from which fibres pass by way of the anterior spinal roots through communicating branches to the cervical sympathetic ganglia.

From these the pathway leads to the Gasserian ganglion and its ophthalmic (ciliary) branches to supply the dilator muscle, which is normally in a state of tonus.

The sphincter pupillary muscle is supplied by the short fibres from the ciliary ganglion. The fibres of the motor-oculi nerve end within the ciliary ganglion from which the motor limb of the reflex arc is continued by fibres emerging from the ciliary ganglion to the sphincter as previously stated.

Dunn has recently objected to the explanation usually accepted for this light reflex and offers evidence in favor of the view that the reflex arc passes from the retina to the ciliary ganglion from which motor impulses arise and are carried by the motor fibres to the sphincter pupillæ. The Argyll-Robertson phenomenon, according to Dunn, is the result of the abolition of the primary reflex of the ciliary ganglion and the typical phenomenon cannot occur except by reason of a lesion in the ganglion.[27]

It is important, in examining the pupils for defective reaction to light, that each eye be examined separately and to make sure that the reaction obtained is not a convergence or accommodation reaction. This is best controlled by examining the patient in a dark room with the use of a reflected beam of light from the mirror of the ophthalmoscope or a condensing lens; the beam of light should be thrown obliquely, testing from both the temporal and nasal sides.

Normally, a beam of light thrown upon one retina causes contraction of both irides. This constitutes the "consensual" reflex, the loss of which may be one of the earliest manifestations of paretic ocular disturbance. This reflex may also be diminished or absent when the usual direct method of examination shows the light reflex to be present. In 70 per cent. of paretics the pupillary light reflex is sluggish or abolished (Franz).

Inequality of the Pupils.—This symptom may be said to be second in diagnostic importance to disturbance of the light reflex. Pupillary inequality may be produced by several kinds of defect of motility,

considered from the standpoint of both eyes. If one pupil is normal or approximately so, and the other is contracted (myotic), the inequality will be less marked than when one pupil is myotic and the other dilated (mydriatic). One pupil may be normal while the other is dilated, usually the result of iridoplegia. Sometimes the pupils may be reduced almost to pin-point size, yet unequally so; the same holds true of the dilated iridoplegic pupils.

Pupillary inequality occurs in some normal persons, and also in several mental disorders other than paresis.

The writer has observed inconstant but marked pupillary inequality present during comatose states, but disappearing with the return of consciousness; also inequality which appeared at the beginning of a coma has been observed to disappear as the coma deepened.

Facies, Tongue, Lips.—In the cases in which there is an early appearance of mental dulness or a depression, the wiping away of the natural muscular tone of the facial distribution is plainly evident. When there is mental hyperactivity with rapid play of the facial muscles, alternating with periods of quiet, there is, nevertheless, distinct evidence of the loss of tone of the muscles of expression, which gives rise to the so-called "ironed-out" facies. In periods of mental activity and especially during speech, fine tremors of the orbicular muscle and of the muscles of the angles of the mouth are commonly observed. In more advanced phases the tremors may involve the muscles of the cheeks (zygomaticus), the frontalis and orbital regions. The tremors are distinctly fibrillar, as are those of the tongue and lips, and are an indication of muscular weakness and incoördination. Coarse tremors of the tongue belong rather to advanced phases of the disease. When the tongue is protruded beyond the line of the teeth, fibrillary tremors of groups of muscle fibres especially along the lateral margins and at the tip of the tongue are characteristically marked. As the muscular weakness of the tongue increases, the organ is protruded with much greater difficulty and in extreme weakness can be held out only for a moment at a time. If the patient is urged to keep the tongue out and greater effort is consequently made to protrude the tongue, the tremor becomes more marked and may involve the entire organ, which slides in and out in "trombone" fashion (Magnan).

Disturbance of Speech.—In the early stage of paresis impairment of speech is often not pronounced. Only occasionally, more especially during transitory excitement, the patient may be noticed stumbling over certain words containing such combinations of consonants as "sp" and "th," or double consonants. Special test words and phrases are usually employed for the detection of speech defects; for example, "Massachusetts Artillery" or "Methodist Episcopal." The words are often "drawled out" and syllables are omitted, interchanged or reduplicated; there is commonly an unusual pause between syllables which gives rise to the "hesitating" speech.

In general it may be said that the speech of the typical paretic is slow, tremulous, drawling and hesitating. Sometimes distinctly "scanning" speech is observed, similar to that in insular sclerosis.

The disturbances which serve to produce the defect of speech are in fundament disorders of coördination of the speech apparatus musculature. When the disease has become well advanced, the speech disturbance may become so profound that articulate utterances are made only with great effort, or speech may be practically obliterated, all attempts at articulation becoming useless.

Disturbance of Handwriting.—This disorder is partly mental and partly due to motor weakness and incoördination. Distinct errors in spelling, the omission or repetition of letters and syllables, are defects of mental origin. The style of writing is usually changed from the patient's normal, the characters are either larger or smaller, the lines

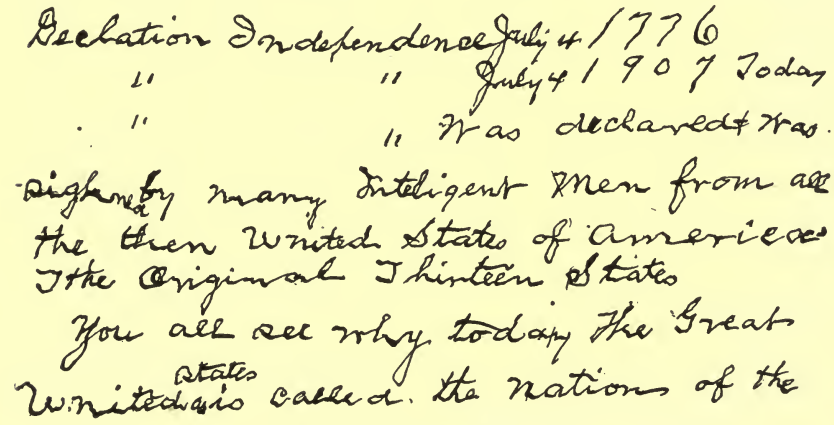


Fig. 70.—Specimen of handwriting in paresis.

composing the letters tremulous and wavy and the characters as a whole unevenly formed and frequently out of line (Fig. 70).

General Motility Disorders.—The motor disturbances previously indicated are due to muscular weakness and incoördination.

The first defect noted in the extremities are those involving the more finely coördinated muscle groups. Fibrillary tremors of the muscles of the limbs, occurring as frequent contractions of groups of muscle fibres, are common and usually may be intensified by voluntary effort, especially by effort to maintain a fixed position. Fine tremors of the small muscles of the hand are seen best when the fingers are fully extended and widely separated.

General muscular incoördination is usually present in some degree, giving rise to awkwardness of gait and bodily movement and incoördination of station (Romberg sign).

Motor Weakness.—General progressive muscular weakness occurs

practically in all cases, but in some instances local palsies of varying degrees, which may be either spastic or flaccid, occur in different muscle distributions. Monoplegia involving the face, arm or leg is common and frequently transitory. Hemiplegia when present is usually partial, often transitory, and may be accompanied by aphasia of the motor type. Complete paralysis of all extremities with marked spasticity and strong contractures is most likely to occur in cases of several years' duration. In these the patient's voluntary movement may be practically absent, with the exception of feeble attempts at speech.

Late in the disease there is difficulty in deglutition; the food is held in the mouth for a considerable time before the reflex for swallowing is excited, which may be accompanied by choking.

Alterations of the Reflexes.—In the majority of instances there is some alteration of the reflexes, either in the form of excessive activity, sluggishness or absence. The superficial reflexes are found not infrequently diminished, and at the same time the deep reflexes exaggerated. For example, a large and quick knee-jerk may be present at the time that the plantar jerk may be sluggish or even absent.

The patient's mental state often interferes with accurate examination of the reflexes. On this account, in eliciting the deep reflexes, care should be taken to note any contraction of opposing muscles (*e.g.*, the hamstrings) at the moment the patellar tendon is struck.

The **patellar reflex** is occasionally normal, but as a rule it is exaggerated, diminished or absent; each of these conditions as presented may vary from time to time. Commonly the reflexes of the two sides are unequally exaggerated or diminished or one reflex may be absent and the other remain normal or moderately increased.

The **Achilles reflex** may be diminished or abolished, while the knee-jerk is preserved or increased. It is not uncommon to find the patellar reflex absent or greatly impaired, while the biceps reflex is preserved or may even be exaggerated.

On the whole, it may be said that in the majority of cases some of the deep reflexes are exaggerated. In about one-quarter of the cases the patellar reflexes are abolished or diminished, due to the involvement of the lower (spinal) neurones, as in the tabetic type of paresis.

Special Senses.—Disturbances of sensation are not uncommon. The most frequent are deafness and visual disturbances. Deafness is often accompanied by tinnitus, which may be pronounced, especially if due to central disease. A patient in whom deafness was marked in both ears, developed tinnitus, which he interpreted as being caused by external sounds, and therefore concluded that his hearing had returned. His defective judgment, however, did not allow him to observe that it required just as great effort to make him hear words spoken. The writer has observed transitory deafness following paretic seizures.

Visual defects are the result of optic atrophy which may be sufficiently pronounced to produce blindness, as occurs in tabes.

Taste and smell may be disordered as a result of nerve involvement or may be due to faulty perception. General tactile sensibility is frequently impaired, as may be sensibility to pain. Striking examples of this were observed in two patients, one of whom fractured the left femur and insisted upon massaging the injured limb; another paretic, who developed a large carbuncle on the posterior thoracic region, suffered little inconvenience when the same was surgically treated without anæsthesia.

A patient with marked ataxic gait staggered and reeled against an open door, which the weight of his body closed on the little finger of the hand he put out to save him from falling. The finger was so badly crushed as to require amputation. Neither the injury nor the surgical operation seemed to inconvenience him, although no anæsthetic was used.

Disturbances of sensation which the patient refers to a definite part of his body are common. It may be difficult to differentiate sensory experiences which are of mental origin from paræsthesias due to organic disease in the sensory pathway and from abnormal bodily sensations which are due to disturbances of the organic sensations. The patient often complains of extreme general weakness and inability to rise from bed; he may say that he is dead, that an extremity is not his own or that it is wood or leather. More common still are feelings of numbness, tingling, burning, "electric shocks," and "stabbing" or neuralgic pains. One patient said that his left hand had "three thousand degrees of heat in it." Patients suffering from localized pains have been found to show focal lesions in the posterior part of the internal capsule. The cases presenting paræsthesias are usually among patients whose paretic disorder is characterized in its early phases by a distinctly hypochondriacal symptom complex.

On the whole, it may be said that the pure sensory disturbances are in the minority when compared with the disturbances of motility.

General Somatic Disturbances.—Sooner or later in the course of the paretic's disorder there appear disturbances of the functions of digestion, elimination and of nutrition and metabolism in general. These, in many instances, are to be attributed to secondary visceral changes dependent upon defective innervation. Although the appetite of the paretic is voracious and he seems to digest his food fairly well, his tongue is usually thickly furred and the breath heavy or fœtid. As the patient usually eats very rapidly, impairment of the digestive functions is thus favored, if not actually hastened. Usually there is constipation, which may alternate with diarrhœa, especially when the lower bowel is impacted with fecal concretions. In the early stages of the disease the paretic is apt to lose in weight; later, as the disorder advances, especially if the patient has settled down to regular life of the hospital, he begins to add to his weight, in which he may increase twenty or thirty pounds in a few months.

Vasomotor and Trophic Disorders.—General vasomotor disturbances are common to all phases of the disease. Fainting or syncopal attacks lasting but a few moments occur frequently. The so-called "congestive attacks" are characteristically present in the majority of cases. These will be described under "convulsive phenomena." In some instances the vasomotor disturbances are marked by the sudden appearance of congestion of the face with injection of the ocular vessels, rapid pulse and respiration, with or without a rise of body temperature (Fig. 71).

Trophic disturbances are frequent and may appear early in the

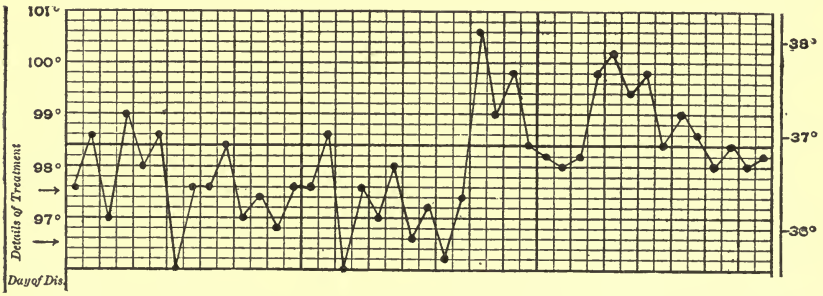


FIG. 71.—Temperature chart of a paretic patient with moderate temperature rise accompanying "congestive attack." Note a subnormal temperature preceding the seizure.

form of herpes and various skin eruptions. Late in the course of the disease the gingival mucous membrane is apt to become swollen, spongy, bleeding easily, and in some examples there is an apparent hyperplasia of the membrane in the form of redundant extensions of the gum beyond the line of the buccal and labial surfaces of the teeth.

The body temperature shows in some cases slight variations from the normal, while in others there is often a more or less continued elevation. During convulsive attacks, or other crises and for a time after the seizures, the temperature is usually two or three degrees above normal for a number of days. Less commonly there may be hyperpyrexia attending the seizures (Fig. 72).

More serious trophic disturbances in the form of bed sores and abscesses occur as the result of pressure upon cutaneous structures overlying the bony prominences. The reduced resistance of the skin, together with the sluggishness of the venous circulation, are perhaps the most important predisposing factors in the production of these changes. Frequent massage and manipulation of the tissues over the bony prominences will do much towards a reduction of the tendency to the development of the so-called trophic changes of this type.

General bodily wasting as the result of nutritive disturbances is common. As already noted, for a time there is an accumulation of flabby fat which usually has a brief existence, and when it begins to disappear is rapidly absorbed. Not infrequently in the space of several

months the patient may take on and lose weight alternately. Usually toward the termination of the disease, though not always, there is more or less rapid emaciation, which in some cases reaches an extreme degree resembling marasmus.

Convulsive Phenomena.—More than one-half of the cases of general paresis are subject to attacks or "seizures" of a convulsive character. These may occur in the form of typical epileptiform or apoplec-

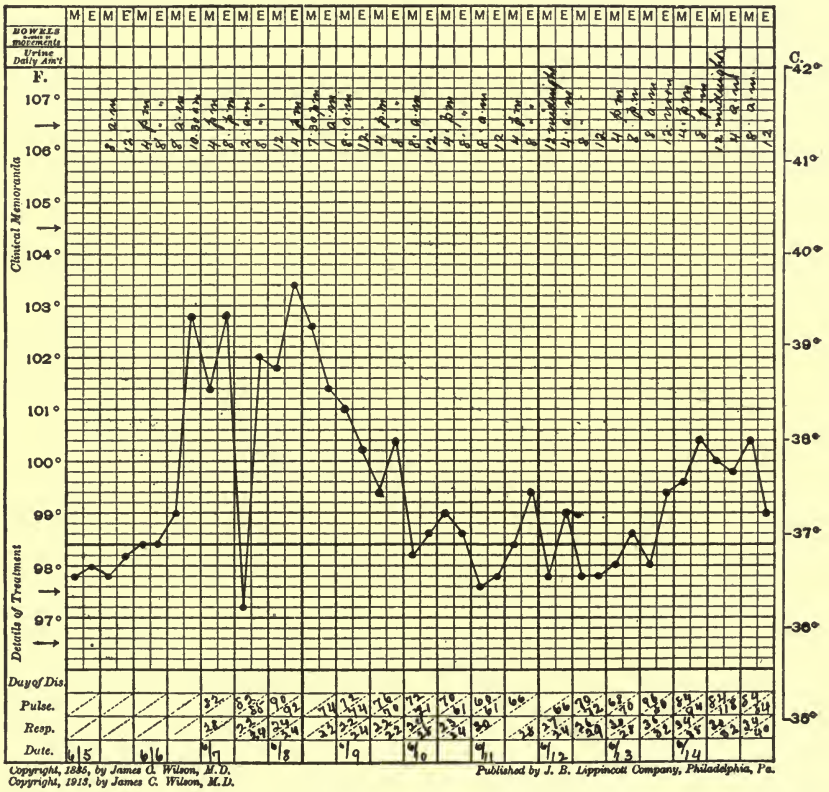


FIG. 72.—Temperature chart of a paretic patient showing temperature elevation accompanying convulsive seizures.

tiform attacks or the so-called "congestive attacks," or paroxysms with stupor or coma. Any or all of these attacks may be accompanied by a sudden elevation of temperature with suffusion of the blood-vessels of the head and face and may be followed by vomiting and temporary mental clouding. Some attacks resemble those of uremia and are doubtless of toxic origin. Usually, following each seizure, by careful observation and comparison of the mental status of the patient before the attack with that following the attack, it will be found that the deterioration advances more rapidly after each seizure.

In some instances the convulsive seizures are severe and prolonged, developing into a typical *status epilepticus,* consisting of a hundred or more convulsions in twenty-four hours. Projectile vomiting has been observed by the writer in a few cases. In all these instances it occurred within twenty-four hours of the termination of life, and the vomitus was mixed with large quantities of blood which had been extravasated from the congested digestive mucosa.

The more typical convulsive attacks resemble those of epilepsy in their general outward manifestations and are regarded as evidence of the organic character of the pathologic process which invades the various regions of the cortex, resulting in more or less temporary neuronic changes which precede actual cellular destruction.

In addition to increased mental enfeeblement there are transitory aphasia and palsies of varying distribution, disturbances of vision and hearing. Sometimes the convulsion is general, as in typical epileptiform convulsions; in other instances they are limited to twitching of a single extremity or muscular groups. Facial monoplegia, paralysis of a single extremity or complete hemiplegia may follow the attack as a transitory or permanent motor loss.

Occasionally the convulsions may be typically Jacksonian. In a case observed by the writer the patient suffered frequently occurring clonic convulsive movements of one arm for several days without loss of consciousness. The movements later gradually spread, involving the leg and left side of the face and finally became general and were attended with loss of consciousness.

The apoplectiform attacks are those which occur without convulsion, are attended with more or less clouding of consciousness or coma and are accompanied by one-side weakness or paralysis, with or without difficulty in speech and deglutition, and are usually not the result of gross focal lesions.

Some patients are able to withstand several convulsions or apoplectiform attacks and go about in comparative comfort in the intervals. Others, especially in the later phases of the disorder, are apt to be more seriously damaged, both mentally and physically. Not infrequently a series of convulsions or an apoplectic attack terminates the course of the disease.

Occasionally one meets cases of the so-called "fulminating" type of paresis in which, following a period of mental and physical prodromes lasting several weeks or a few months, the patient grows rapidly weaker, passes into a state of stupor and dies from respiratory and cardiac failure.

Remissions of Symptoms.—A characteristic clinical feature of general paralysis is the tendency to the occurrence of remissions of symptoms, particularly from the mental standpoint, which to the untrained person are apt to be misleading and give rise to false hopes for recovery. These patients may return to a state of comparative mental

clearness and in some instances apparently there is a return to normal lucidity of mind. Many of the physical signs show marked improvement, although careful examination will show their presence as residual symptoms. There is usually a slight degree of muscular weakness or hypotonus, especially in the facial group; an occasional indication of incoördination, especially in the muscles governing the more delicate motor mechanisms, especially speech. There remains some alteration of the pupillary reactions and the exaggeration or diminution of the deep reflexes, especially the patellar reflex. So striking are these changes for the better in some cases that the improvement is phenomenal. The patient may change from a state of total mental dilapidation, with frequently occurring convulsive attacks and stuporous states, to a condition in which he seems to be restored to a normal state. Such remissions last on an average about six months, though not infrequently continue for a year, eighteen months or more. When the symptoms return they come on suddenly, as a rule, and progress more rapidly than at the time of the first onset, often ushered in with a convulsive attack.

After the disease has run a course on the average of about three and one-half years, evidence of widespread cortical destruction makes its appearance, and the patient lives on solely by means of the lower cerebral and bulbar neuronic mechanisms. Death occurs as the result of one of the described crises or bronchopneumonia or other intercurrent disease.

Diagnosis.—The differential diagnosis of general paralysis from other psychoses and other organic diseases of the nervous system is of general importance from several standpoints. In some cases the diagnosis is extremely difficult.

The principal reason for the urgency lies in the fact that the disorder may progress without manifesting symptoms sufficiently clear to arouse the suspicion of any but the expert, and even the trained observer may diagnose paresis when it is not present or may fail in the reverse.

From the standpoint of the practical importance of the diagnosis may be involved the decision as to whether the patient is to be restrained or is to be permitted to continue with business ventures and run the risk of carrying out plans which might ruin his family, financially or socially, or both.

For example, a man of unquestionable character and integrity, abstemious in habits, a devoted husband and father, becomes morose, depressed, irritable and subject to outbursts of anger upon slight provocation or even without apparent reason. He shows memory lapses, makes mistakes in business, his accounts show errors and his business transactions indicate that he is not the shrewd business man he was formerly considered. Physical examination shows pupillary disturbance, a slight facial tremor, an occasional slur of the speech, alteration

of his writing, slight incoördination and altered deep reflexes and cerebral attacks of some sort. Laboratory findings reveal positive Wassermann reaction in blood and spinal fluid; lymphocytosis in spinal fluid (10–20 cells per cu. m.m.); colloidal gold reaction presenting the characteristic paretic curve and the globulin content increased; with such a picture the diagnosis is certain and therefore presents no difficulty.

The cases which do present difficulties are those in which the mental symptoms are based upon diffuse syphilitic meningitis, syphilitic arterial disease, arteriosclerotic brain disease in patients formerly syphilitics, diffuse cerebral arteriosclerosis, brain tumor, epilepsy, chronic alcoholism and severe types of neurasthenia.

The meningeal syphilitics present, like the paretic types, loss of capacity for mental work, headache, dizziness and defective memory. In addition, the meningitic cases commonly present transitory paralyses of the cranial nerves and perhaps involvement of the extremities. In meningeal disease the palsies are of longer duration, as a rule, but respond to antiluetic treatment. Well-marked sensitiveness of the skull to percussion with the presence of disease of the optic nerve, together with other cranial nerve involvement, according to Nonne,[20] belong to diffuse syphilitic meningitis. The mental disorder in the meningitic disease is apt to be a gradually increasing mental dulness, which may lead to dementia without the symptoms of irritability which are so common in paresis. Some examples of the meningitic forms may involve the cerebral substance so as to make the diagnosis of clinical paresis extremely difficult.

Diffuse brain syphilis of vascular origin is still more difficult. It is this type of patient that taxes the diagnostic acumen of both the clinician and the histopathologist and opens the way for the discussion as to whether a differentiation can be made between the two conditions. Perhaps the therapeutic test is the most reliable if we are able to exclude the remissions which occur in true paresis, both with and without antiluetic treatment.

Cerebral arteriosclerosis, especially when it appears before fifty-five years of age in an individual who is known to have had syphilis and who suffers from transitory paralyses and mental enfeeblement, presents no little difficulty in diagnosis.

In the general arteriosclerotic other visceral manifestations can usually be detected; the paralytic symptoms are more permanent, and there is apt to be greater improvement in the mental symptoms as time goes on following the paralytic attack. In the paretic, on the other hand, the paralytic symptoms may improve while the mental deterioration advances progressively.

In the diffuse forms of arteriosclerosis in a syphilitic the clinical diagnosis often must be based upon the absence of the typical physical signs; pupillary disturbances in paresis involve the light reflex alone,

as a rule, while in the arteriosclerotic both the light and accommodative reflexes are affected, if at all. Remissions are not present in the arteriosclerotic; the course of the disease is longer than that of the paretic; focal symptoms are more pronounced and lasting; speech disturbances are often lacking and constitute a dysarthia or persistent aphasia, as compared with the usual incoördinate speech and transitory aphasia of the paretic; the same may be said of the disturbances of writing.

Chronic alcoholism sometimes simulates paresis but lacks the pupillary changes.* The differentiation of alcoholic conditions from the paretic is more or less easily cleared by the aid of the laboratory findings.

Brain tumor without definite focal symptoms and with mental symptoms preponderating may at first sight seem to resemble paresis. The general symptoms of intracranial pressure—especially neuroretinitis and papillœdema and with the absence of the laboratory reactions—should be sufficient to clear the diagnosis.

Neurasthenic states are often presented by the early or prodromal phases of paresis. In fact, there is no essential difference in the symptomatology of true neurasthenia and that of some cases of early paresis. The laboratory reactions must here suffice until physical signs of sufficient diagnostic import are made manifest. A neurasthenic with pupillary fixation, the result of an earlier syphilitic iritis, can only be differentiated by the reaction with the spinal fluid test.

Prior to the introduction of the laboratory aids in the diagnosis of syphilitic disorders the differentiation of paresis from some of the functional psychoses, especially the manic and depressive psychoses, presented considerable difficulty. It should not be overlooked that syphilitics suffer from functional types of mental disorder.[21]

Interstitial Types—Vascular, Gummatous and Meningitic Forms.—In contradistinction to the parenchymatous type of cerebral syphilis represented by general paresis just described, the interstitial forms of cerebral syphilis in many instances do not present mental symptoms other than dulness and somnolence. The principal features which characterize this grosser type of lesion are headache, optic nerve changes, resulting in neuritis and atrophy, and localizing lesions, such as motor oculi and other cranial nerve palsies. In acute cases in which pronounced mental disturbances occur the symptoms may be due to the direct action of the infection as a result of the invasion of the body fluids by toxic materials, giving rise to similar mental pictures as are seen in the infection (toxic) psychoses (q. v.) and are characterized by the hallucinatory and confusional states already described.

Focal symptoms are chiefly found in diffuse or localized involvement of the meninges and are usually produced by lesions located at the base of the brain. If, as less frequently occurs, the cortical region alone is affected, there are apt to be convulsive attacks as the result of involvement of the motor area. In such cases without cranial nerve

* Pupillary changes have been attributed to alcoholism by some observers.

affection, pupillary involvement does not occur as a rule; at least, the typical Argyll-Robertson pupil is usually absent. Palsies of the extremities and aphasias are common, are more persistent than in the parenchymatous (paretic) type of syphilis and are more pronounced in proportion to the mental symptoms. The mental disorder is usually that of enfeeblement without the disordered emotional tone (euphoria) and the delusional content. There are chiefly mental fatigue, dulness, somnolence, memory defects, imperfect perception and apprehension. Attacks of transitory confusion are apt to follow apoplectic attacks or epileptiform convulsive seizures, which are frequently Jacksonian in type. In fact, all of the mental symptoms follow physical signs, which is in contrast to the order of occurrence in paresis. The speech defects are more distinctly paralytic in grosser cerebral lues and is therefore more distinctly a motor defect, whereas in paresis it is both motor and mental, as is shown by the disarrangement of syllables and the stumbling, hesitating character of the speech.

Treatment.—The results of studies concerning the pathogenesis of general paralysis have led to the conclusion that the offending organisms, the *treponemata,* must be capable of continued life for a number of years without seriously interfering with their host, until a time arrives when a change is produced either in the treponemes or in the condition of the host which permits the invasion of the nervous system. Observations of Fordyce [22] and others point to the early infection of the cerebrospinal fluid in some cases of syphilis. Fordyce believes that at least 25 per cent. of syphilitics have positive findings during the first year of the infection and that patients who present nervous symptoms, which may disappear under active treatment, are nevertheless potential candidates for tabes, paresis or some other form of cerebral syphilis, until a negative blood and spinal fluid has been obtained by persistent treatment. It is important to bear in mind that the spinal fluid may be positive with but few clinical signs, such as headache, or a transitory diplopia which disappears after a few weeks of treatment.

One of the most important phases of the treatment of paresis which has been given more than usual attention recently is that of **prophylaxis.** Present-day experiences make it apparent that the syphilographer and the neuropsychiatrist must either combine their forces, or the syphilographer must train himself for the examination of the patients from the neurologic viewpoint and qualify himself for the interpretation of his findings. The general trend of opinions in regard to the treatment of neurosyphilitic disorders, especially those of the parenchymatous forms, points to the belief that in order that the condition may be ameliorated in any marked degree, *it must be attacked early.*

From the prophylactic standpoint the spinal fluid of every syphilitic should be subjected to laboratory examination in order that the patient

may be reasonably assured that by reason of the fact that the spinal fluid is not infected he is not a likely candidate for cerebral lues. Fordyce believes that if, after two years, the spinal fluid is normal, one can safely promise the patient that he will not develop cerebrospinal syphilis, with the possible exception of gumma and the arterial forms of the disease, such as may accompany a general arteriosclerosis. Needless to say, the surest remedy lies in the prophylactic treatment.

If that phase of the care of the syphilitic has been overlooked, as soon as mental symptoms arise in a person known or suspected to be syphilitic (the possibility of lues must be considered in every psychosis), the blood and spinal fluid should be examined with reference to the "four reactions," especially if the blood serum reacts positively with the complement-fixation test. A negative blood-serum reaction in a patient presenting speech defect, however slight, or any deviation from the normal pupillary reaction, with alteration of the deep reflexes, should be looked upon with suspicion and given the benefit of the doubt in favor of a spinal-fluid examination for evidence of invasion of the central nervous system by the organism of syphilis.

As far as is known, antisyphilitic measures, such as have been known for a long time to act favorably in gross cerebral syphilis, such as the meningitic and gummatous forms, have little or no effect upon the course of general paresis. In a few instances active mercurial treatment is followed by a remission of symptoms and general improvement in the patient's condition; in other instances, under the same treatment the patient may grow worse. The writer has seen severe mercurial stomatitis follow a course of inunctions given to patients presenting strong evidence of clinical neurosyphilis with laboratory signs positive in the serum and spinal fluid.

The explanation commonly offered in defence of the failure of the older forms of specific therapy to influence the clinical course of paresis was based on the ground that degenerative processes once having taken place in the nervous tissues, repair is impossible, as there is no structural provision for the regeneration of nerve-cells. An equally important reason exists in the fact that in all probability the remedies administered *do not reach the affected tissues.**

According to Halliburton, there is no proof that the cerebrospinal fluid is an exudate from the blood. In fact, readily diffusible substances and poisons introduced into the blood experimentally do not escape readily into the cerebrospinal fluid as they do into ordinary lymph. "The difficulty," Halliburton states, "is quite intelligible when we regard the choroid plexus as a stalwart barrier

* In order to accomplish this, it is obvious, that the remedial agent must be carried to the parenchyma of the cortical substance either by way of the cortical blood-vessels or by the perivascular and pericellular channels, which, in the light of recent investigations, it seems cannot take place. The only route remaining is, therefore, by way of the cerebro-spinal fluid.

which keeps back these materials, and only allows its own normal secretion to escape." [23]

More recently, with the advent of arsphenamine preparations, the hope arose that by intravenous injections of the arsenical compound better results might be obtained than with the older specific therapy. In the meanwhile it was demonstrated by Willcox [24] that after intravenous injections of salvarsan no arsenic could be detected in the brain, although all the other viscera contained considerable quantities. Later the attempt was made to attack the nervous system directly by intradural medication with arsenical compounds, a method which was followed not only by therapeutic disappointments but also by untoward effects.

Various modifications of the salvarsan medication were then tried, among which the most useful seemed to be the Swift-Ellis method of injecting the intradural space of the spinal cord with the patient's blood serum, drawn about two hours after an intravenous injection of the arsenical preparation.

Still more radical measures have been applied with the view of getting the remedy directly in contact with the cerebral cortex. This method arose as the result of the statement of Head and his coworkers that the pathological reaction in the cerebral tissues (neural and neurogliar) is the result of a sensitization of those tissues through the infection of the lymph stream by the spirochætes or their products, and that the end result is analogous to anaphylaxis and that the offending material is produced on the spot, hence antisyphilitic remedies are unable to influence the condition because they are unable to reach it.

To overcome this obstacle the treatment has been directed through trephine openings into the subdural space and into the lateral ventricles. Cotton, Hammond and Sharpe and others have reported improvement in a large proportion of cases thus treated. Some of the patients returned to work and were self-supporting. Two of Hammond's cases were reported apparently normal for more than a year, but are regarded still in danger of recurrence. The physical signs were influenced but little, the tremors and speech disorder improved, but the pupillary and other reflexes remained as before treatment. The laboratory findings in the blood serum, cerebral fluid and spinal fluid examined before and after the treatment showed negligible changes.

The greatest difficulty encountered in the treatment of the paretic is that which concerns the comparative inaccessibility of the central nervous system by means of therapeutic agents and on account of the fact that the results of the infection are so widespread and so little, if any, of the remedy actually reaches the affected structural elements.

Most investigators have failed to find any trace of arsenical contamination of the spinal fluid after treatment except in those cases in which the subdural space has been entered directly. Barbat found one part per hundred thousand of metallic arsenic following the ad-

ministration of the full dose of neosalvarsan. Gilpin and Early, Pillsbury and Finlayson have employed mercurial inunctions, followed by spinal drainage. Daily inunctions of 50 per cent. mercurial ointment are given, and after a lapse of ten days a lumbar puncture is made and spinal fluid in varying amount up to 40 c.c. is drawn.

The combined intravenous therapy and spinal drainage seems to offer the most rational basis of treatment. To supply more or less continuously a cerebrospinal fluid which is being renewed with a chance that it may contain spirochæticidal substances carried indirectly through the blood-stream, or substances capable of neutralizing toxic materials produced at the site of the pathological process, will come nearest to fufilling the requirements of the condition without danger of untoward effect.

The problem then further resolves itself into the selection of the best suited remedy for the individual case.

All early cases may be regarded as neurosyphilis and treated as such until the symptoms warrant the assumption that the case is one of true paresis and that a widespread neural degeneration has taken place. If the spinal fluid escapes from the lumbar puncture under marked pressure, drainage in connection with the intravenous injections will be of temporary advantage at least. It is remarkable that little, if any, discomfort follows the removal of from 20 to 40 c.c. of spinal fluid in some cases, doubtless due to the fact that the fluid is renewed very quickly. After removal of the fluid the patient should be kept in bed as a precautionary measure and the foot of the bed elevated.

The technic usually employed is practically that of Swift and Ellis for the administration of arsphenamine preparations, preferably neoarsphenamine, for the initial injection, in order that the reaction may not be too severe at first. Six to nine decigrams of the drug are administered intravenously, following which at the end of one hour sufficient blood to yield from 10 to 30 c.c. of serum is withdrawn. The serum thus obtained is centrifuged for one-half hour, inactivated for one hour at 56° C. and injected intraspinally on the following day. The head of the bed should be lowered after the injection into the spinal space. There is usually a reactionary rise in temperature to 100° F. or slightly above, with more or less headache in most instances. The injection treatments are repeated cautiously in a week or ten days according to the character of the reaction and the presence of irritative symptoms. In favorable cases the injections may be made weekly until four or five grams of the drug have been administered, in the meantime checking the Wassermann reaction, the cell count and the globulin content as well as the colloidal gold reaction of the spinal fluid. No prediction can be made as to the results to be expected from the treatments; some observers have noticed that remissions are of longer duration and are more frequent since the introduction of the arsphenamine preparations. Other workers have noted that the duration of the

disease as a whole is shorter in those treated with the arsenical medication than in cases treated by other methods.

With respect to the general treatment of paresis it is important that the incipient paretic be placed under conditions most suitable for mental and physical rest. In practically every case this can only be secured by a change of environment such as will remove him from his accustomed associations with business, family and friends. Under the tactful ministrations of the physician and properly trained nurse the paretic, so difficult to control at home on account of the stimulating effect of family and business influences, is usually easily managed.

The diet should be carefully selected, relying chiefly upon milk, vegetables and eggs, and eliminating as far as possible all stimulating foods, particularly alcoholic beverages. The general bodily condition should be carefully studied with reference to the digestion and the eliminations and treated symptomatically. Careful attention should be given to the hygiene of the mouth, which is commonly neglected by the paretic. In the euphoristic phase of the disorder the paretics usually bolt their food and are prone to suffer from indigestion. Constipation, if present, is likewise very apt to be neglected by the paretic and therefore requires close attention. Ordinary stomachic tonics and digestives combined with laxatives are usually called for, temporarily at least, in most instances.

In the treatment of active phases of excitement careful consideration of measures to be used for the control of insomnia and excessive motor activity must be given attention. For the drug control of mental and physical activity in paretics larger doses of sedatives and hypnotics frequently are required than in patients suffering from other psychoses; on this account the administration of drugs for the purpose of sedation not only interferes with eliminative functions, but may actually prove dangerous from their depressing effect upon the circulation. Warm baths are safer and are beneficial from the sedative standpoint and also in favoring elimination, when given at 96°–99° F., and continued for one-half to three-quarters of an hour. At the same time, cold compresses should be applied to the head and the nape of the neck.

When remissions of symptoms appear, careful additions to the diet may be made, continuing, however, the interdiction of alcohol and stimulating condiments. After the patient has gained some benefit from a régime of quiet and regular hours, if the excessive activity of mind and body has largely disappeared, an out-of-door life is beneficial, provided the patient is amenable to control. Moderate physical exercise may be allowed under competent supervision.

In some instances the remissions are so pronounced that relatives are often prematurely stimulated to the belief that a cure has actually been accomplished. Extreme caution should be observed before deciding that the patient is to assume charge of business affairs or return to former activities. Such a move can safely be permitted

only under such restrictions as may depend upon the conditions in each individual case.

The treatment of the " seizures " requires attention in the matter of the attending cerebral congestion and fever, the gastrointestinal tract and the urinary bladder. Convulsive attacks are treated much in the same way as are the attacks of ordinary epilepsy from the standpoint of protection of the patient from injury. On account of the marked cerebral congestion usually present, the application of cold to the head and nape of the neck is indicated as it is for the elevation of the temperature. For twenty-four hours at least the diet should be restricted to liquids, and the bowels cleansed by enemas followed by normal salt solution by bowel and a saline purge. In instances in which the seizure begins with vomiting, care should be taken for several days not to overtax the digestive functions. Careful selection of the diet and its preparation so as to take care of the patient's neglect to sufficiently chew his food, will materially help to reduce the frequency of the seizures. Vigilance concerning the bowel condition is important for the same reason.

Urinary retention, which not uncommonly accompanies the seizures, may arise in any phase of the disease, which fact calls for careful oversight in this respect. On account of the obtunding of the sensory portion of the vesical mechanism the bladder may become distended by retention without the knowledge of the patient. When this occurs and overdistension follows, the bladder should be catheterized at eight-hour intervals at least, in order to give the bladder muscle an opportunity to regain its tone if possible. Needless to say, the most rigid asepsis should be employed to prevent cystitis. As an additional safeguard, hexamethylene in five-grain doses may be administered two or three times daily, dissolved in at least two-thirds of a tumbler of water.

When the disease reaches the stage in which the speech difficulty becomes very marked, there is also danger of a sudden, transitory failure of the swallowing mechanism. To prevent accident from choking the food should be finely cut or ground and slowly fed to the patient. In the late stages of the disease the diet should be limited to liquids. At this period in the disorder the hygiene of the mouth becomes a matter of still greater importance, on account of the helplessness of the patient, the lowered resistance and the increased liability to infection.

The care of the skin demands frequent attention, especially in bedridden cases, with the object of preventing bed sores. These may begin on the heels, sacrum, trochanters, malleoli or any locality where there is too great pressure over bony prominences. The sluggishness of the circulation favors the exudation of serum into the subcutaneous tissue, giving rise to blister formation, which, if not carefully treated, may involve the deeper tissues, resulting in their necrosis and sloughing. The prevention of pressure, daily light massage of the tissues over the

bony prominences, inunctions with olive oil or cocoa butter, rigid cleanliness and freedom from residual urine, absence of wrinkles and bread-crumbs on the under sheet of the bed will go a long way towards the prevention of the much-to-be-dreaded bed sores so often attributed to trophic changes.

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CHAPTER IV

THE SCHIZOPHRENIC PSYCHOSES—THE DEMENTIA PRÆCOX GROUP

REACTIONS APPEARING DURING THE EVOLUTION PERIOD, ARISING OUT OF INHERENT BIOGENETIC DEFECT, TERMINATING FREQUENTLY IN NEURONIC DEGENERATION AND CHARACTERIZED BY AN INTERFERENCE WITH THE ADAPTIVE MECHANISM THROUGH INEFFICIENCY OF THE SENSORY, EMOTIONAL AND VOLITIONAL PROCESSES

THE term dementia præcox is applied to a group of mental disorders appearing chiefly during the period of adolescence, representing abnormal reaction types arising upon the basis of maladjustments formed during the period of mental development. These reaction types represent, therefore, the failure of the individual to normally make adjustments to environment and are, furthermore, marked by a precocious mental deterioration in the majority of cases.

Dementia præcox includes the representatives of the clinical types described by Hecker in 1871 under the term hebephrenia and by Kahlbaum in 1874 under the name katatonia. Clouston described the same reaction types under the mental disorders of adolescence. In 1890 Pick concluded that hebephrenia belonged to the disease which Schüle a few years before had named dementia præcox.

Kraepelin, in 1896, in the fifth edition of his text-book, included the clinical pictures described by Hecker and Kahlbaum under the one head—dementia præcox—on the ground that hebephrenia and katatonia were but clinical varieties of the same disorder, to which he added paranoid dementia, thus giving a place to many of the delusional types which were formerly included under the term paranoia.

The Kraepelinian classification was promptly accepted by many psychiatrists, especially on the European continent and in America, and the dementia præcox group became recognized as comprising the three types: the hebephrenic, the catatonic and the paranoid.

Strong opposition to the use of the term dementia præcox has been offered by some authorities and is responsible for considerable discussion. Objections brought forth from British authorities, some of whom were unwilling to accept the term, were stated on the ground that dementia præcox had not found a definite place in psychiatry, for the reason that the term was used to denote many types of mental disorder, some of them occurring as early as puberty and others appearing in advanced life.

Of the Italian school, Bianchi states, "As regards dementia præcox, I find no sufficient reason for elevating it to the position of a clinical entity; it is an offshoot rather than a disease, and, whether it

develops in adolescence, youth or maturity, presents no difference in its clinical features."

Some of the objections to the use of the term were based upon the wide variations in the age at which the disorder is said to occur, and, therefore, it was said by some that the term præcox (precocious) was not applicable. Again, the term dementia was considered objectionable for the reason that some patients seemed to recover. To this was also added the objection that the deterioration is not a true dementia.

In the last decade the recognition of the symptom-complex has gained favor with some English psychiatrists. Bolton [1] employs the term "premature dementia," as coördinate of the terms mature, presenile and senile dementia to describe the cases of "primary neuronic dementia" occurring between puberty and maturity and which in the initial stages exhibit a certain severe grade of dementia.

It has been suggested that the term be applied to indicate that the mental deterioration occurs earlier in the course of dementia præcox than in other types of mental disturbance.

The controversy has given rise to the conclusion that there is no one characteristic by which the dementia præcox symptom-complex can be defined, but that it must be regarded rather as a complex characterized by an aggregation of symptoms the result of disorder of several mental processes, chief among which are disturbances in the emotional, volitional and ideational spheres.

In later editions of Kraepelin's text-book further subdivisions of the original tripartite division have been made, but the fundamental conception in regard to the disorder remains practically unchanged.

Bleuler has proposed the term "schizophrenia," to indicate the "splitting" of the personality, which he regards as the fundamental symptom, to which are added the secondary symptoms, those of the psychosis, the mental abnormalities existing as latent symptoms. Among the fundamental symptoms are disordered association processes, loss of interest, characterizing the emotional disorder, and a peculiar tendency to become mentally excluded from the outside world, to which Bleuler gives the name "autism."

The acute symptoms, such as hallucinatory, delusional and catatonic episodes, he regards as accessory. The cause of the disease process Bleuler considers to be due fundamentally to some toxin, but he also regards the secondary and accessory symptoms as due to mental cause; that is, they are psychogenic in origin.

The psychoanalytic school of investigators has offered an explanation of the origin of the symptoms in dementia præcox upon a purely psychobiological basis. Especially by Freud, Jung and Adler, and by White and Jelliffe in this country, strong support has been given to pure psychological explanations of the pathogenesis of the disorder. According to this viewpoint, the formation of delusions has as its

basis certain "wish-fulfilling mechanisms" which are the same as in normal persons, but the reactions differ in that the dementia præcox patient, on account of his neurotic constitution, is unable to "adequately utilize them"; this results in the splitting of the personality of Bleuler, already mentioned, and produces the withdrawal from reality, which in turn gives rise to the disturbances of attention and lack of interest and the apparent dilapidation of thought. The hallucinatory phenomena are, according to the psychoanalysts, symbolisms of a "conflict," while the delusional content is the outcome of psychic factors which are a part of the individual make-up and therefore are a part of the personality. The delusions become modified and variegated by the influence of "complexes," which are important factors in the building of the personality but which have been forgotten by the patient and therefore have been relegated to the "unconscious." The disorders of movement seen in the mannerisms, stereotypy and neologisms are "indicators" of the nature of the conflict. The catatonic rigidity is a still more successful attempt at shutting out of the world from mentality to the extent of complete inattention to environment.[2]

The objections offered in regard to the psychoanalyst's interpretation, as stated by Osnato,[3] are that there seems to be lacking a clear separation of dementia præcox cases from the neuroses, the hysterias and the compulsions; that there is an insufficiency of scientific data, these having been replaced by psychological descriptions upon which the conceptions of the pathogenesis of dementia præcox are founded. The same observer well concludes that the therapeutic test applied to the principles laid down by psychoanalysts is the only criterion upon which to base an evaluation of those principles as applied to dementia præcox. From the statements of Kraepelin, Bleuler, Tanzi and Meyer, it is clearly recognizable that there are certain fundamental points which mark the dementia præcox patient; these are: (1) the lack of proper connection between the thought processes and the emotional and volitional reactions; (2) the disorder or defect of emotional tone; (3) the attitude presented by the patient, which results from the feeling that his thoughts and actions are controlled by some other influence than his own efforts.

Etiology—The causes which have been assigned to dementia præcox are numerous and various. The fact that several points of view have been reached by different observers who have given much study to the subject indicates that the causes are certainly multiple and probably not the same in all cases.

Heredity doubtless plays an important part, and inborn factors are generally regarded as necessary for the development of the disorder. A history of actual familial psychopathy can be obtained in 50 per cent. to 70 per cent. of inquiries.

Kraepelin has adhered closely to the theory that the disease is the result of an intoxication originating in defective secretory func-

tion of the sex-glands. This hypothesis has for its support the fact that the symptoms appear at the time of sexual development and not infrequently with the occurrence of pregnancy, especially with the first gestation. That the disease is toxic in origin is suggested by the presence of disturbances of nutrition, vasomotor paresis and exacerbations of nervous symptoms with epileptiform attacks and periods of transitory stupor.

Inherited predisposition and endogenous intoxication are inadequate as causative factors from the standpoint of pathogenesis. This has been demonstrated to the satisfaction of competent neuropathologists by the fact that in hallucinatory cases, regarded clinically as dementia præcox, cell changes have been found in the temporosphenoidal convolutions and in the parietal cortex in brains of patients exhibiting catatonic symptoms.[4] These findings are sufficient to indicate that dementia præcox presents a pathological morphology of the cortical neurones. The question of whether the histological changes are "incidental" or belong to the "agenetic" type of defect is yet to be answered.

The lessons taught by biology, especially in reference to the mechanism of inheritance, lay great stress upon the negative character of the causal factors which have been designated by such terms as "degeneracy," "psychopathic tendency," "constitutional inferiority" and other similar expressions.

The "neuropathic predisposition" is a *negative* factor, rather than an active causative agent, representing an *absence* of continued ability to carry on functions normally. This is indicated in some individuals who are so constituted as to require less of a given exciting factor in order to disturb normal function.

According to Hoch,[5] the psychosis in dementia præcox is colored by the personality. Bleuler, Meyer and others regard the personality as representing a serious defect of mental constitution, which has led to the formation of bad mental habits and consequent faulty adjustments to reality; these observers hold also that dementia præcox contains a great deal that is based upon congenital intellectual defect, which becomes associated with, but not a part of, the disorder. Hoch[6] states that in 50 to 60 per cent. of his patients the trait which he termed the "shut-in tendencies" existed before the breakdown, and that only a relatively small percentage were quite natural, frank, open and well balanced mentally.

Bleuler has promulgated the doctrine that the factors influencing the faulty reactions and adjustments are psychogenic in origin.

With regard to age incidence it may be said concerning the clinical varieties of dementia præcox that the hebephrenic occurs, as a rule, in the cases of early onset; the catatonic occupies the second position in point of age, and the paranoid form occurs nearer the period of mental maturity. The majority of cases have their onset before the

twenty-fifth year, taking all forms of the disorder into account. Comparatively few examples begin after thirty years of age, although occasionally one meets with psychoses in the third and fourth decades, which are difficult to differentiate from dementia præcox. It is usually the catatonic and paranoid forms which present the greatest difficulties in this direction.

Many patients break down at or about the time of puberty, apparently under the physical and mental stress associated with cerebral functional changes and the general effect of the metabolic changes incident to that period of life. Marked mental disorder may appear at this time in individuals of relatively high intellectual capacity and also in defectives. The outcome of the attack results in a "greater or lesser degree of psychic infirmity" (Kraepelin) and probably depends upon the amount of damage done to the nervous elements as the result of the exciting cause which precipitated the break.

Some patients recover sufficiently to return to their former mode of life, but, when comparison of the mental state before the attack is made with that following the supposed restoration, a certain amount of enfeeblement can be found to exist. In these cases recurrence is not infrequent and is usually followed by an increased mental enfeeblement which may reach a terminal deterioration before the climacteric. Kraepelin terms these deteriorations (Verblödungen) "endogenous" on the ground that they seem to occur without distinguishable extrinsic causal factors.

Some patients appear from the onset of the attack to rapidly progress towards a grade of deterioration, which is reached in a number of months, and which appears to remain stationary for many years. This class of patients constitutes about 15 per cent. of the permanent residents in mental hospitals.

General Symptomatology.—An important clinical fact is the very apparent mental disorganization which appears in the precocious dement. The dementia is peculiar in that it does not involve all the mental processes equally in the same patient; this fact has furnished a basis for objection to the use of the term. For example, there is little real impairment of memory, which in true dementia is usually the first symptom indicating irrecoverable mental loss.

According to Kraepelin there is "a peculiar disorganization of the inward coherence of the psychic personality with **predominating damage to the affective life and will.**" These patients appear to have little disturbance of apprehension; they are able to understand what is going on about them but without being able to show any apparent interest; they may, with a remarkable degree of clearness, describe happenings and physical changes about them, as, for example, wearing apparel of the attending physician or the furnishings of a room.

Orientation is practically preserved, although questions asked may be answered in such a way as to make it appear otherwise.

Attention is always impaired seriously, although often there is exhibited a morbid curiosity concerning relatively unimportant matters.

Hallucinations.—Sensory falsification is regarded by many observers as a fundamental symptom in dementia præcox. Bianchi [7] goes so far as to include dementia præcox in the symptom-complex, which he terms "sensory insanity," on the ground that "the almost constant fact is the hallucinatory explosion of the disease." The hallucinations are often sufficiently active to control the flow of ideas and thus add to the incongruity of thought, for the reason that the relation between the flow of ideas and the character of the hallucinations is not coherent. A patient annoyed by auditory hallucinations may carry on a brief verbal battle with his supposed enemies, while between the hallucinatory seizures his general attitude may not indicate that he entertains ideas of persecution.

Memory.—In proportion to the total mental disorganization, memory is but little affected. Remote events are recalled with surprising accuracy; mental acquisitions of early life are often well retained, and recent events may be recounted in detail. The impairment of memory which actually exists appears to be the outcome of enfeebled attentive power, by which the number of impressions becomes smaller, and the store of memories accordingly diminishes as the field of mental activity becomes contracted. Loss of interest in experiences likewise aids in the ultimate effacement of memories through lack of attention, as is true of the normal mind.

Emotional Disorders.—As indicated in the Kraepelian definition of the dementia præcox complex, the "damage of the affective life" is a predominating characteristic. Involvement of the emotional sphere is one of the earliest and most profoundly affected of the mental processes. The majority of cases show an almost characteristic emotional neutrality or indifference, exhibited by a lack of interest; any attempt to urge upon the patient an interest in his surroundings usually is met by a responsive irritability.

Paradoxical emotional states form a conspicuous symptom. Silly laughter without adequate cause and tearful outbursts without occasion frequently interrupt the listlessness and apparent obliviousness to environment. The mental state of the dementia præcox patient has been characterized as an "ataxia" between emotional and conceptual activities (Stransky).

Train of Thought.—In the process of association of ideas considerable disturbance exists, giving rise to a characteristic looseness of the interconnections of the psychic content. Ideas that are entirely disconnected as to content may be associated so as to give rise to marked incoherence of train of thought. The fact that the patient's expressed ideas are not in accord with the emotional state stands out conspicuously.

Judgment.—In dementia præcox there is practically always some

evidence of defect in the reasoning process. The defect may be so marked as to give rise to pseudosystematized delusions as in the paranoid types. The delusions are commonly hypochondriacal and depressive in content and often not in accord with the emotional indifference displayed. One patient complained of "eye trouble," which made him receive impressions wrongly and therefore interfered with his doing the right things and thus prevented his getting along with his associates. Another patient maintains that he has paresis as the result of self-abuse; another says that as a result of her sins she has lost her soul, her mind is gone and brain dried up, while she is still able to sew, knit, play games and even write storiettes; these capabilities she explains are not the work of her brain, but of the devil into which she has been transformed.

Some patients present a transitory euphoria expressed in ambitious terms and in the form of impossible, child-like fabrications, so expressed that they take on the appearance of grandiose delusions. Thus, a young man calmly states that on a previous night he made a trip down through the earth and up through the air; that on a trip to Washington he made a million dollars on a patent. Another time he calls himself an Indian prince; he says that he is 4000 years old; that he built the pyramids; at one time that he is Jesus Christ, at another time God, and again that he is the devil; that he can compose music with a fewer number of notes than are usually employed. Another patient says he is a ghost and that he has been embalmed.

Insight is always lacking in the dementia præcox patient. He may complain that something is wrong with his mind or that some one is interfering with his brain, but he is incapable of comprehending the fact that the disorder is as marked as it is. The delusions ultimately fade with the decrease in the activity of mental processes and with the increase of emotional indifference.

Volitional Disorder.—The tendency for the volitional responses to become displayed by automatic or impulsive reactions is marked in most cases of dementia præcox.

At first there is a lack of initiative, resulting from a disinclination towards effort of any kind; this may become more marked and pass into a state of stupor only to be interrupted by attacks of aimless excitement with the impulse to destroy or self-injury. The ordinary volitional activities, such as walking, are often interrupted by impulsive acts or may be replaced by hypersuggestibility, negativism, stereotypy, mannerisms and statuesque attitudes.

Later in the course of the disorder there is acquired a "stolidity of conduct"[8] (Tanzi), which is almost pathognomonic. "Whatever be the clinical variety to which his malady belongs, the patient suffering from dementia præcox displays the disorder of his intelligence, not so much by what he says as by what he does, which acts are characterized by their purposelessness."

Conduct and Behavior.—That the dementia præcox patient exhibits his mental disorder largely by his actions may be readily seen when one studies the disorders of volition and conduct in the average patient. Voluntary activity is greatly diminished in most cases, and in some it is entirely absent. This reduction in general activity is commonly one of the earliest symptoms; the patient sits idly for hours, or lies in bed all day. In addition to the general inactivity there is a tendency to impulsive acts. A patient lying quietly in bed, apparently inattentive to his surroundings, may suddenly without warning or reason jump out of bed, strike another patient, seize a piece of furniture and demolish it, destroy bed clothing, tearing it into strips, or break whatever object happens to be near. Serious accidents of the nature of assaults are usually the result of such impulsive acts. Many disorders of conduct described under the general discussion of catatonia are the result of the characteristic motility disorder which may give rise either to diminution or increase of bodily activity. In states of catatonic rigidity there may be an actual increase in tonicity of the entire skeletal musculature of such degree as to produce a state of general bodily immobility. In some instances there is retention of urine and bowel contents for long periods.

Repetition of bodily movements and the striking of attitudes as the result of the repeated occurrence of the same impulse are accountable for the stereotyped movements and mannerisms of speech and action so frequently seen in the catatonic. The impulsive acts and other motility disorders which appear late in the course of the disorder seem to be fundamentally the result of disordered neural activity; that is, they have the appearance of being non-mental in origin.

There is much in the conduct of many precocious dements that strongly suggests a reversion to the infantile or child-like type of reaction. **Echolalia,** the involuntary repetition by the patient of words heard, and **echopraxia,** the repetition of acts performed in the presence of the patient, may be regarded as representations of the tendency to revert to the childish characteristics of imitation. The symptom we term negativism, which plays so conspicuous a part in dementia præcox, appears fundamentally to be a characteristic seen in every-day life among normal children. The reaction is often confounded with bashfulness, as in the case of the child who, in the presence of strangers, refuses to talk and pulls away from the person who endeavors to entice him forward, but, as soon as apparently unobserved, tries to enforce attraction upon his antics, is a familiar example. The grimacing and distortion of the features and other muscle groups in children during voluntary effort, such as when the child attempts to write or is being drilled in acts requiring new efforts at coördination, as in learning steps in dancing, are common examples to be found in the normal. This extraneous muscular activity is much greater in some children than in others. In dementia præcox the mental attitude and the dependent reactions are often distinctly

puerile. The relation between the motility disturbance and the emotional status seems to have an anatomical as well as a physiological basis. According to Mills, muscle tone belongs functionally to the cerebral cortex, but is separate from the projection system. There are special areas of representation connected with the sensorimotor apparatus on which the "*tonectic*" excitations exert their influence. Mills regards the zone to which these excitations are referred as located in the mid-frontal region, while the striatum is an association region where the excitations from differentiated cortical centres for tone are grouped. The affects or tone impulses of the various cortical sense centres are conveyed to the mid-frontal region. The mid-frontal zone is regarded as an independent zone or as an anterior subdivision of the general motor zone in which are represented those movements concerned in the expression of emotion, including the visceral, vascular and secretory movements, all of which, as previously indicated, are merely physical concomitants of emotional expression (see Pathology).

Spasmodic laughter and spasmodic crying, so commonly seen in the catatonic, may thus be regarded as phenomena which result from abnormal states of tonus.

To summarize, dementia præcox, as defined by Meyer, includes "those types of defect or deterioration which show the existence or the development of fundamental discrepancies between thought and reaction, defects of interest and affectivity with oddities; dreamy, fantastic or hysteroid or psychasthenoid reactions, with a feeling of being forced, of peculiar, unnatural interference with thought, frequently with paranoid, catatonic or scattered tantrums or episodes."

Physical Signs.—The majority of somatic disturbances found in dementia præcox usually make their appearance much later than the mental symptoms.

Early in the disorder there is some physical reduction shown by loss of weight and anæmia; these are due, in part at least, to loss of appetite and digestive disturbances, usually accompanied by constipation. Circulatory disorders are usually present in the form of cardiac arrhythmia, compressible pulse and vasomotor instability, which give rise to dermatographia. Œdema and cyanosis of the extremities appear later in the course of the disorder. These are often accompanied by coldness of the hands and feet with excessive sweating, especially of the palms and fingers, which phenomena are nearly always present in the catatonic.

Disturbances of the reflexes are characterized by an exaggeration of the tendon reflexes and the abolition or marked diminution of the cutaneous plantar reflexes. The cutaneous epigastric, cremasteric and abdominal reflexes remain normal, as a rule.

The increased patellar reflex, together with a loss or diminution of the plantar reflex, are frequent coexistent signs, especially with the peculiarity of the patellar reaction in which the leg remains in partial extension after the tendon has been percussed.

These reflex disturbances are regarded as functional and are inconstant, varying in intensity in the same patient.

Eye Symptoms.—According to Hoch,[9] the so-called psycho-reflex is frequently absent; that is, the pupillary dilatation which is normally associated with psychic activity, mental effort and emotional changes and sensory stimulation.

Dilatation of the pupil with some interference with the light reflex has been observed to follow pressure made over the ovarian region; this, Hoch notes, is different from the condition which is found in hysteria, namely that the dilatation which occurs with ovarian pressure is not accompanied by alteration of the light reaction. Other eye changes, such as hippus, anisocoria, changes in the fundus vessels and even papillœdema, have been observed.[10]

The Pilcz-Westphal phenomenon consists in the contraction of the pupils when the patient attempts to close the lids while they are forcibly held open by the hand of the examiner.

The pupils are usually regular, that is, circular in outline, and equal, although the shape of the pupil may change in catatonic stupor. Inequalities may appear but usually are transitory. The responses to light and with accommodation are frequently sluggish, but these responses are not lost at any time, nor are they dissociated. Satisfactory examination of the patient for this symptom is often made with difficulty, hence the variation in clinical reports regarding the pupillary condition. Cutaneous sensibility is almost always diminished (Regis).

The urine presents, according to some investigators, variations as to quantity, density and composition. The amount is greatly diminished, according to Crocq only 600 to 800 grammes in twenty-four hours, especially in negativistic cases, while in the catatonics there is polyuria. There is an increased specific gravity with diminished nitrogen compound elimination and excessive phosphates and chlorides. Then renal activity has been shown to be diminished in all cases, as shown by the methylene blue color test.

Menstruation is usually absent early in the course of the disorder as the accompaniment of the anæmia usually seen in young girls.

The physical signs are frequent in the hebephrenic and catatonic types, but less marked in the paranoid type of dementia præcox.

Some advanced dements become greatly reduced physically in spite of the regularity with which they are fed. It has been pointed out by several observers that many dementia præcox patients develop tuberculosis. According to Clarke, fully one-half of the subjects die of tuberculosis.

Pathology.—The aim of the clinician from a purely scientific point of view is reached when he correlates the pathological findings in a given disorder with the symptoms presented by the patient. In the case of the schizophrenic group of psychoses there is still much that is present in the symptom-complex that is not explained by the pathological findings.

The indications are that the more serious organic affections of the nervous system in dementia præcox are the result of long-standing functional disorder and are possibly of toxic and infectious origin (Regis). Lesions described by the early writers, Hecker and Kahlbaum, are in no sense characteristic of dementia præcox.

More recently Alzheimer, Nissl, Kraepelin, Kleist, Sioli, Southard,[4] Dunton, Rosanoff, Morse and others have added to the literature upon the subject. Alzheimer [16] adheres to the opinion that dementia præcox is an organic disease of the brain. He describes definite changes in the form of shrunken nerve-cells with infiltration by lymphoid cells; atrophy of nerve-cells and their ultimate disappearance, together with proliferation of neuroglia cells among which are found amœboid glia cells.

Southard,[4] as previously mentioned, in 89 per cent. of the cases examined, found areas of gliosis and diminution in the size of the convolutions and satellitosis; that is, neurophagocytic cells in the vicinity of the ganglion cells, especially at the bases of the pyramids. These satellite cells are regarded as of glial origin, but not of the type which produces glia fibres. Sioli [17] describes cytopathological changes with emphasis upon the increase of Scharlach-stainable lipoids in the degenerated nerve-cells and degenerative products in the nervous tissues, while Rosanoff [4] observed cortical changes which led him to the conclusion that a relationship exists between the brain atrophy and the degree of mental deterioration.

More striking findings from the standpoint of the relation of pathology to symptomatology are those described by Morse.[15] The changes noted were usually found late in the disease, although in subjects who died early enough to permit of exclusion of arteriosclerosis and other senile degenerative changes and consisted of increase in the neuroglia in the nuclei of the thalami. Compared with other brain diseases with lesions in the basal ganglia, as in progressive lenticular degeneration (Wilson's disease), in which there is marked lack of emotional control without other mental symptoms, the similarity of the two sets of lesions and the corresponding emotional instability in both Wilson's [19] disease and dementia præcox is rather striking.

Studies in metabolism in dementia præcox by Pighini and Statuti and by Ross have resulted in establishing the fact that metabolism is not normal, and that the amount of sulphur excreted is above the normal. In the light of the fact that the nervous system exceeds the other tissues in its sulphate compound content, these metabolic studies are significant.

1. Simple Deterioration

Mental enfeeblement and emotional disturbance shown by changes in disposition constitute the conspicuous symptoms of this type of dementia præcox.

Mode of Onset.—The time of onset is usually indefinite and cannot

be recognized in many instances. The mental change comes on insidiously and is manifested solely by a gradual replacement of the natural disposition by a state of apparent indifference, mental sluggishness, loss of interest in friends, family, school, play or work. In the beginning of the disorder, when the characteristic inattentiveness appears, relatives frequently credit the patient with "laziness" or "wilful indifference." The patient becomes seclusive, shuns company, prefers to remain in bed, often leaving it only to take food. Attempts to rouse the patient from this state of indifference are usually met with outbursts of irritability or violence. In some instances there may be a history of one or more previous attacks of the same character which have been regarded as attacks of "nervous prostration" or nervous breakdown. Following each episode, however, there is an increased mental incapacity with inability to accomplish anything in the world. Among adolescents of the better classes of society they are permitted to live lives of inactivity, while individuals of the middle and lower classes are likely to drift into the tramp class where few demands are made upon them. The patient's habits indicate extreme carelessness in the matter of personal care and cleanliness. Early in the course of the disorder subjective symptoms may be in the foreground and mask the real mental state. The symptoms are in some respects similar to those usually described as "neurasthenic," to which a hypochondriacal element may be added. The youth thus affected commonly complains of headache, dizziness, marked sense of fatigue after slight exertion, vague bodily pains, insomnia and mental depression. In a few cases there is a period of mental exaltation. This, when it occurs, is usually of brief duration, a few hours or days at most.

The recent experiences incident to the draft into the army of adolescents from all strata of society have shown that as soon as individuals of predisposed type are obliged to make definite adjustments they break under the strain of effort, show their inherent defects in the form of acute psychic disturbance or by an inability to conform to regulations of army life and, therefore, commonly get into difficulty for military offences, such as overstaying time of leave or actual desertion. In some cases of increased mental and motor activity there is a strong tendency to roam about at night or even to wander away from home, travelling without apparent object.

Symptoms.—Hallucinations are less frequent than in hebephrenic, catatonic or paranoid types of dementia præcox, and when present are fleeting, whatever their character, whether visual or auditory.

The conspicuous sensory disorder is usually found to consist of indefinite morbid sensations, which account for the general bodily discomfort. True hallucinations are more frequently of hearing, although any or several of the senses may be implicated.

Delusions are not a conspicuous part of the picture on account of their transitory character, but are always indicative of the immature

mind in which they find a place. Perhaps the most common delusive idea of the patient is that his parents or friends are not treating him well. These morbid ideas are not given any explanatory foundation. Commonly the delusions depend for their content upon the character of hallucinations, either voices, strange sounds or visions. These patients gradually develop greater mental enfeeblement, becoming incapable of any but the simplest manual labor under constant supervision. They lose all interest and have no ambition or desires except for food and sleep. The disorder may continue without progress for many years until the patient dies of some intercurrent infection, especially tuberculosis.

2. The Hebephrenic Type

The hebephrenic type of dementia præcox differs but little in its fundamentals from the foregoing type, but is likely to be more pronounced in its symptoms, more acute in onset and more protracted in its course. The early symptoms are often similar to those of an acute psychosis with active hallucinations, fleeting delusions and emotional excitement, sometimes with depression; frequently the mental disturbance resembles a confusional state or a delirium.

In young women there may be prodromal symptoms at the time of the menstrual periods, or exacerbations of the mental symptoms already present. On account of the tendency of the train of symptoms to show remissions, the complex may simulate a manic-depressive psychosis, especially in patients who suffer from alternating periods of depression and exaltation. The depressed cases are quiet and dejected in appearance. The patient may exhibit fear of some malignant disease, of death, of neglect by the family, or that he is discriminated against by former friends and associates. There is a total loss of interest in environment and a failure to make adjustments.

Among the milder exalted cases there is a moderate grade of euphoria during which the patient gives expression to grandiose ideas of wealth and ability.

Symptoms.—Hallucinations are common in the more active cases, usually in the form of voices which accuse the patient of wrongdoings, demanding of him a sacrifice of life in order to save others. One patient says that everything is good but herself, begs frequently to be saved; will not admit the identity of her parents; her father is an impostor; she thinks that other patients are persons who have been persecuting her; insists that other women about her are men disguised, who have been her persecutors. Prominent personages are seen by the patient among people about her; she sees the President and the Kaiser. It is at times difficult, on account of the changeability of the affective tone of the patient, to determine whether some of the perceptive disorders are true sensory disturbances or not; many of the patient's statements indicate that the sensory disorders are illusory as often as they are hallucinatory.

Attention held easily for short periods is soon lost. During attacks of excitement it cannot be gained. In quiet intervals the patient may complain of lack of concentration, that he is unable to read or think; that something possesses his mind which prevents control of thought.

Memory is implicated but little in the early phase of the disorder, especially with reference to impressions of remote events. For happenings during the episodes of excitements or periods of clouding there naturally is but a hazy recollection. As the disorder progresses and the attentive power becomes weaker, the memory processes are indirectly involved and recent occurrences cannot be recalled.

Emotionally, as already noted, there is severe involvement of the affective tone. The lack of congruity between the emotional tone and the ideas expressed is almost always pronounced. The patient who insists that she must be killed, and who has made several attempts to cut through her breast into the heart, when told her ideas are erroneous, calmly states with a smile that her ideas are very precious and that she would not part with them for any others. She seems in terror one moment and at another moment is diverted to react in terms of pleasurable emotion. Her attitude toward persons about her is likewise subject to rapid change; one moment pleasantly conversing and the next moment threatening or even assaulting her nurse.

Periods of profound **depression** with or without psychomotor activity are frequent. Protracted crying spells, for which the patient can give no adequate explanation, are not uncommon; likewise causeless laughter or perhaps more properly attacks of laughter induced by stimuli which in the normal would be inadequate.

Very commonly an attitude of emotional indifference dominates the picture. The facies are expressionless; stimuli are met with little or no response, except occasionally by ill-timed giggling or show of anger or irritability. Attacks of **excitability** are common in the hebephrenic as has been suggested by the descriptive term "juvenile mania." In these attacks there are marked psychomotor activity, rapidity of flow of thought and emotional exaltation, but this differs from the manic type of reaction largely in the lack of goal in the train of thought and the inconsistency of the emotional and ideational content.

As the disease advances the emotional tone becomes more or less uniformly one of **indifference.** There is diminution or loss of the natural affections so that interest in friends and relatives is lacking. The patient now sits idly, or lies in bed, giving no indication that he is affected by happenings in his immediate environment. One patient, when told of the death of his father, smiled and replied that he could bring him back to life again by striking him on the head.

Disorders of judgment are usually marked, appearing early in the course of the disorder and are expressed in the numerous and childlike, impossible, delusive ideas, not infrequently of a grandiose character. They believe themselves unusually endowed with accomplishments and

ability; the student is about to reveal to the world the product of his inventive power in the construction of new electrical devices; he has a new philosophy to offer to the world for the solution of social problems or the maintenance of health; thus, a young man reasoned that while at college he had gotten wrong ideas about sociology and that he had discovered how to correct them, namely, that in order to prevent the increase of defective children he would advise altruistically inclined men to marry degenerate women but would avoid having children; in this way doing the world a great service. Another patient says he is a great inventor; at another time he is God and at another the devil.

The delusive ideas are commonly elaborated upon by the patient in relating fanciful fabrications. A young man gave evidence of great pleasure in relating experiences with Indians, Aztecs, Arabs and Egyptians and his ability to bring to life the ancient dead.

Conduct.—The periods in which the patient is dominated by these impossible delusional trends are often terminated by maniacal episodes with extreme restlessness; he shouts, screams, sings or weeps; is impulsive, combative and destructive. Not infrequently there are reckless suicidal attempts as the outcome of self-accusatory ideas. A patient says that she is a murderess and should be punished by death and soon after threatens to kill the nurse if she enters the room; later wants to be burned at the stake as a vicarious sacrifice for the world; on another occasion says that she is Jesus Christ; refuses food for fear that it is poisoned. On still another occasion she asks to see her baby; again states that her pelvic organs have been changed to those of a man; that she is no more human but divine; that she has cured many persons by playing on the piano, or is the Redeemer of the world.

Conduct in general is characterized by gross inconsistencies like those of the emotional state. The general attitude of the patient when not actually depressed or exalted is one of childlike silliness; the patient laughs, giggles and grimaces. One patient runs about stamping and puffing and blowing like an engine. Many of the acts of the hebephrenic appear like exaggerations of childlike mischievousness, but without any adequate reason; thus a patient built a fire in the house, another patient tried to take down the cellar stairway. Often patients seem to talk to themselves, laughing aloud without adequate reason.

The patient's speech content is indicative of the loose character of the associated ideas in thought content. Commonly the utterances are limited to a few fixed phrases which are expressed with a mixture of coined words, senseless repetitions and stereotyped phrases. Not infrequently the patient assumes the attitude of "putting on airs," in speech utterances in the form of stilted phrases. The writing of the dementia præcox patient contains many senseless repetitions, a sort of verbigeration in writing. The script is usually profusely embellished with shading, scrolls and underlines and an excess of punctuation. Sometimes entire letters may be written in code.

Physically, the patient at first shows a marked reduction and a condition of general malnutrition. The skin is cold, moist and inclined to be cyanotic. Digestion is impaired, the appetite is poor and the bowels constipated. Menstruation may be absent for long periods, only to return with irregularity.

The pupils are usually dilated and slow in reflex response. The deep reflexes are commonly exaggerated while the superficial reflexes may be sluggish. There are vasomotor disturbances shown by the cyanosis and dermatographia.

As the disorder advances and the mental excitability subsides, the patient often takes on weight rapidly and may become excessively fat. In this state patients may remain in a stationary mental condition, with occasional outbursts of irritability or impulsive violence for many years. Ultimately there develops the characteristic mental deterioration. They are usually mute, uninterested and show no external manifestations of mental activity. They are entirely without initiative, sitting idly for hours wherever they are seated.

They require an initiating stimulus in order to be able to carry out the simplest commands. They are careless, slovenly and even dirty in habits. Occasionally such patients will show a brief "flare-up" of mental activity when a few sentences may be spoken in response to a question. This will subside as suddenly as it appears and the patient lapse into his state of sluggishness and helpless indolence.

The progress of the disease is towards total mental dilapidation in three-fourths of the cases. In the earlier editions of Kraepelin's text-book he stated that "in about 8 per cent. of the cases the symptoms of the disease entirely disappear, leaving the patients in apparently their normal condition."[11] In the eighth edition, however, he is unwilling to estimate the number of recoveries for the reason that it is impossible to state how long a remission will last. In some cases relapses occur after several years.

In about 15 per cent. of the cases mental deterioration is less rapid and does not reach as great a degree as in the majority. These less impaired patients may be employed in some useful occupation, provided they are sufficiently supervised. In another group the symptoms appear to subside and the course of the disorder seems to be arrested. If these patients return to their former environment, it is quite evident that they are out of place and are unable to follow any useful occupation on their own responsibility. They soon fall into habits of indolence, unless carefully watched and kept under a mental discipline of the nature of re-education. Sooner or later, however, in spite of efforts to keep the patient's activities in channels of useful pursuit, there is manifested a lack of real interest with an inability to make progress.

Finally, apparent recoveries are in most instances only near-restorations, and probably all in this group show clearly that they are not capable of the same mental life which they occupied prior to the attack

of mental disorder. Inasmuch as no one ever advises the hebephrenic who has broken down during a collegiate term to return to the same activities, even though he has all the appearances of a complete restoration, the crucial test is in reality never applied. Attempt to enter into the competition of a business life is likewise frequently followed by a failure to make proper adjustments and is sometimes followed by relapse. These patients are content with such occupation as employment in a dairy or farm life would offer or to engage in work which does not entail responsibility or intellectual capacity.

In the average case the active symptoms abate, but the patient shows distinct mental impairment. These patients are able to fit into the routine of hospital life, apparently contented with their position in life, and with no thought of their needs or what is to become of them in future years; they entertain no ideas of responsibility for their own support nor of their families. They rarely acquire new knowledge, as the attentive power is enfeebled and impressibility slight and memory is not dependable. Some of these patients live to an advanced age with progressive advancement of the mental deterioration. The delusions and hallucinations fade and the irritability and restlessness subside as age advances.

3. The Catatonic Type

The catatonic variety of dementia præcox has been so named on account of the fact that the conspicuous features of the disorder are the result of a motility disturbance, dependent upon an alteration of muscular tonicity. This dysfunction in some instances is so widespread as to involve both the skeletal and the visceral musculature. The catatonic patient represents one of the best examples of failure of the adaptive mechanism—the nervous system as a whole—the cerebrospinal and the autonomic nervous system.

Although usually described in connection with the group of psychotics in which muscular tonus is principally involved, catatonic symptoms are not infrequently observed in all types of dementia præcox.

Symptoms.—Fundamentally, catatonia, in its typical examples, is a condition of bodily immobility, superficially resembling spasticity, which may be continuous or intermittent, but differing from true spasticity in that the groups of muscles affected do not correspond to a definite nerve distribution or controlling nerve centre; the rigidity may appear and disappear suddenly. The motor disturbances of catatonia may give rise either to immobility or to excessive activity. In both instances there is the appearance of failure either to initiate activity or to inhibit movements. The movements made are largely automatic, mechanical in appearance and carried out independently of the will of the patient.

The most common manifestation of catatonia is the maintenance of fixed attitudes. Efforts to make the patient change his posture are met with a prompt resistance that is free from voluntary effort. In

some patients this is a persistent symptom, lasting for many months without interruption. It was this fact which led Kahlbaum, who first described the condition in 1874, to denominate catatonia a clinical entity.

Frequently these patients sit immobile, mute, with the eyes closed and the face utterly devoid of expression; the saliva streams from the lips, and the only response to external stimuli may be a winking of the eyelids or a corrugation of the frontalis. Other patients sit with fixed attitude, the eyes staring widely, while still another patient sits rigidly with the orbicular muscles tightly set, the face turgid and strained, as if every muscle were in a state of extreme tension; other patients assume a pouting expression with the lips, and at the same time the eyelids are tightly closed, so that considerable force is required to open them passively. These patients rarely speak, though they will smile at times and even shed tears. When voluntary movements are possible they are usually carried out very deliberately and are often interrupted by purposeless motions or attitudes. During the taking of food the patient may pause with a spoon carried half way to the mouth; another patient holds the spoon at arm's length above his head for many minutes between each mouthful; a third patient holds the food in his mouth for a time before beginning to chew or swallow.

In extreme cases the general muscular rigidity is accompanied by a state of stupor in which the patient lies motionless for prolonged periods. Not only is there persistent muscular rigidity which gives stiffness to the entire body, but this stiffness is increased at the moment when an attempt is made to passively flex an extremity, or even may be increased by the slightest external stimulus.

Such patients may be bedridden for months or even years, living vegetative existences, requiring to be fed by hand or mechanically. They pay no attention to bowel or bladder evacuations; not infrequently there is urinary retention.

In instances in which the involuntary musculature is involved in the tonicity disorder there is commonly regurgitation of food.

The periods of stupor may be suddenly interrupted by attacks of motor excitement, which may vary from a milder grade, in which there are repeated monotonous sound utterances or the rhythmic rolling of the head sidewise, to a more general motor activity in the form of periodic motor-crises. Thus, a patient observed by the writer for a period of more than twelve years has had at intervals of a few weeks attacks beginning with slight movements of the fingers of the right hand, in which she would successively and repeatedly approximate the fingers to the thumb, continuing the movements rhythmically for some time; next the wrist and forearm became included in the movement with a rhythmic beat, later the arm would take on a swinging movement with rotation at the shoulder, as if beating a drum, usually striking the abdomen. Following this the movements would extend to the head with violent alternate contraction of the sternomastoids and the trapezii muscles; at the

same time and synchronous with the beating there were sputtering movements of the lips preceded by a loud inspiratory vocal sound. During the height of an attack the patient presented the appearance of trying to imitate all the instruments of an orchestra at the same time.

Catatonia presents itself in minor but no less distinct forms, among which perhaps the most frequent are the various phases of **negativism.** These consist of reactions which are characterized by an involuntary opposition to external stimuli. The patient's actions are represented in terms of negative reactions towards his natural wants (auto-negativism), and also towards the wishes or commands of others (hetero-negativism). Many patients are mute; they resist taking food; they will not dress, and if helped to dress will remove each garment more quickly than it can be put on. A patient asks if he may go out of doors, yet standing in the doorway resists strongly being taken out; another patient sits on the floor beside the chair but will not sit in it; another patient will not stand, and another will not sit or lie down. Patients frequently show a tendency to hide in closets, crawl under the bed or behind other pieces of furniture. In general it may be said that the patient lives a negative existence for indefinite periods.

Several explanations have been offered in regard to the mode of production of the negativistic state. One view assumes that at the moment of initiation of a voluntary effort there arises an opposing idea to meet it, and the result is an opposing movement. Another regards the opposition as dependent primarily upon a disorder of volition in which there is a complete dissociation of the elements which determine motor impulses and the almost complete loss of control on the part of the subject of his usual acts (Regis). A third assumption, that of Kleist,[12] makes the negative reaction the result of an emotion, akin to " feelings of anxiety, of anger, of joy." Bleuler[13] regards the causes of negativism as the same for the pathological types as for the negative attitude in health, as " one repulses when one does not wish to be disturbed." So does the dementia præcox patient become disturbed; that is, reacts negatively to all external stimuli which tend to draw him from the state of " autism " into the realm of reality, for he is living a dream-life from which he does not wish to be drawn.

Hypersuggestibility.—As the antithesis of negativism, catatonics may present a marked degree of suggestibility, shown by a strong tendency to follow in reaction the commands of others, or even slight external stimuli. Suggestibility may appear as automatic imitation of the acts of other persons—echopraxia—or the repetition of words spoken—echolalia. There is often a tendency for the patient to remain in whatever position his body may be placed, even though uncomfortable, an attitude may be held for incredibly long periods. In catatonic stupor a limb passively flexed may be held in mid-air, or whatever position it is placed, until by gradual increase of muscle fatigue the limb will slowly gravitate until supported. This muscular tonicity with flexibility

is termed "**cerea flexibilitas.**" In the matter of the patient's personal needs, it often requires but an initial suggestive stimulus to bring about the ordinary habitual acts, such as dressing, eating, evacuating the bowels and bladder. Unless such initiating stimuli are applied these patients would go without food and soil themselves persistently.

Stereotypy.—Movements which are carried out in an automatic fashion with a long series of repetitions, while maintaining fixed attitudes and facial expressions, constitute the most common examples of stereotypy. The facial expression altered by persistent grimacing or pouting of the lips, the eyes tightly closed and the lips strongly contracted, constitute the commonly met stereotyped attitudes which may persist for weeks. Added to this there may be an almost ceaseless repetition of sounds, words or even phrases. Some patients give expression to certain stereotyped phrases in answer to everything said to them. "Thirty-cent coffee" was the usual reply when a patient was addressed.

Mannerisms in gait and general activity are in the same way developed, so that the patient may acquire the habit of walking on tiptoe, or of patting his chest each time before he begins to speak. A patient stood sweeping with a broom the same spot on the floor for hours. An attempt to interfere with this movement was met with strong opposition. Causeless laughing and weeping are frequently observed, continuing for long periods. The laughter is often explosive in character, the patient presenting the appearance of trying to avoid laughing. During attacks of excitement there may be continued weeping, with profuse lachrymation. Both laughing and weeping of this type are without apparent cause and do not correspond to any definite emotional state.

In addition to the utterance of stereotyped expressions, there may be senseless repetitions of sounds or words in rapid succession, or the repetition of the same sound or group of words having a similar sound, as fish, mish, pish, dish, etc. This phenomenon is termed **verbigeration.**

The formation of neologisms, often meaningless, is not infrequent.

Newly acquired speech mannerisms characterized by change in the pitch of the voice, commonly guttural in quality, and intonation of speech are commonly met. Sometimes there is complete absence of speech which persists for long periods. Changes in writing are similar to those of speech, such as the repetition of words, often arranged in meaningless fashion, as in the following example:

Par excellence, status quo
neutralization
ecclesiastical government
constitutional government finis—finis—finis
E Pluribus Unum & In God We Trust
Heavens & Earth—Heavens & Earth
Three cheers—Hurrah—Amen

virtue—liberty—independence
Blank—Blank—Blank
Blank—Blank—Blank
Millennium—Heavenium
C O P X Y Z C. O. P. X Y Z
Please excuse Profuse apologies
Please pardon Profuse apologies
Amen Amen Amen Amen
Grand Old Gentlemen
Kingdom, Power, Glory
Communion of Saints
Kingdom Power Glory
Communion of Saints
Dearly beloved mercy on souls

Please excuse Profuse apologies Please pardon	Psyche de Milo & Mr. Blank

Writings are frequently interlined, underscored, decorated with figures, scrolls and attempts at graphic representations.

Mirror writing is one of the rarer examples of disturbances of this character.

In general it may be said that automatism, both active and passive, is in the foreground in the catatonic, largely due to the fact that the emotional sphere is also profoundly affected.

Psychic Phenomena.—*Perception.*—Hallucinations are more prominent in the catatonic than the hebephrenic. Especially common are hallucinations of hearing, tactual hallucinations and morbid organic sensations. Visual hallucinations as well as those of taste and smell are not infrequent. Commonly, although not invariably, are the hallucinations vivid enough to furnish a basis for the formation of delusive ideas. A young man describes the noise of a machine in his right ear, which he says is operated by a woman; the machine is a "psychological instrument," which later becomes "a continual vibratory-echo-voice of a crude-mannered female who repeats, repeats *ad infinitum,* and has been doing so in personal gags. This Chinese torture has been kept echoing night and day and interfering with thought—mocking and repeating. It is the voice of no female I have ever met." Voices from heaven, of spirits or of departed persons, command the patient to perform certain acts. Sometimes these lead to suicidal or homicidal attempts. Visual hallucinations are commonly religious in character; some of the visions are terrifying and threatening. Hallucinations of taste and smell frequently give rise to the idea that the food is poisoned.

Organic sensory disturbances are spoken of by the patient as in reference to the effects of external agencies upon his body. One patient is constantly being affected by a "nunce plant" by which his brain is saturated with metals. To counteract this the patient is obliged to go through certain gyrations in order to dissolve the metals. The same patient says that these persons get hold of his sensations; when walking he retraces his steps at frequent intervals to get back his sensations.

As already indicated, perception of objects and apperceptive processes leading to apprehension of facts of environment are not disturbed to the extent that the general mental condition would seem to indicate. Catatonics, especially, after prolonged periods of stupor, with resistance and apparent inattentiveness, often suddenly pass from the stuporous condition to a state of comparative mental clearness, and may recount with surprising accuracy experiences taking place while the patient was in stupor. A young woman who had been in a state of stupor for many weeks, lying with eyes closed, mute, negligent of bladder and bowels and requiring mechanical feeding, recognized the suit of clothes worn by a visiting physician on two visits to the hospital, the first visit made while the patient was in apparent stupor, the second visit made several weeks later, after the patient had emerged from the stuporous condition.

Consciousness.—As a rule, there is no marked clouding of consciousness, except in cases in which the onset is abrupt with delirium and confusion, especially of the hallucinatory type. As already indicated, apprehension is not seriously disordered. Some patients appear to be clearly able to apprehend environmental facts at the time of emerging from delirium and yet are absorbed in the events through which they have passed mentally, just as one normally, when partly awake, tries to "finish out" a dream interrupted by the oncoming waking state. Thus a patient at the beginning of his psychosis started to make a journey from his home to his college town with the object of talking over with his teacher a problem he was trying to solve for the prevention of the birth of degenerate children. The day following he passed into a state of excitement, followed by confusion and stupor. As he emerged from the stupor several weeks later, he was still desirous of "working out the trip."

Attention is usually gained and held with difficulty. In the state of stupor the attention cannot be gained. Usually there is marked distractibility, especially if there are active hallucinations. In general it may be said that the attentive power shows a degree of weakening, especially of active attention. Passive attentive power is not seriously impaired except in stuporous states, when intense stimuli make no impression.

Memory.—The memory state of the catatonic dementia præcox patient depends upon the degree of attentiveness. Patients cannot

recall experiences with which they have not been impressed, nor be impressed by experiences to which they have been unable to give attention. For this reason there is often apparent memory defect, which really is the outcome of the primary disorder of attention. Furthermore, patients who cannot relate events which they can recall fail because of the same enfeeblement of attentive power. The attention cannot be held sufficiently long to demonstrate the retentiveness which exists.

Orientation.—Except during the clouded or stuporous episodes, the dementia præcox patient is well orientated. Replies to questions are frequently such as would seem to indicate otherwise, while in reality such answers are the result of negativism, rather than of disorientation. Thus a patient, when in a disturbed state, frequently addresses the physician as Mr. B., but in her more quiet moods indicates clearly that she knows his proper name. The same sort of answer may give the patient the appearance of being disorientated for place.

Emotion.—What has been indicated in regard to the emotional states in dementia præcox in general may be said to hold true for the catatonic variety. In the earlier phases of the disorder, if there is any definite disturbance of the emotional tone, it is that of depression. The patients are commonly depressed at the beginning of the psychosis, indicated by the outward bodily manifestations of sadness, fear, anxiety, distrust.

It is sometimes difficult to differentiate this depression from that of the manic-depressive. As has been emphasized by Dercum, the depression does not appear to originate within the patient, but is rather the outcome of ideas that refer to objects or persons other than himself. The true depressive regards himself as the cause of his misery, or the punishment he believes he deserves, while the dementia præcox patient usually, if he gives a reason at all, attributes his difficulty to the influence of others.

The depression also may be said to be lacking in consistency; it is transitory, variable and is often out of proportion to the content of ideas. It is more frequently less profound than the ideas would warrant. Thus, a patient who insists that she is terribly wicked, and does not deserve the care and attention she is receiving in the hospital, is suddenly diverted and apparently totally absorbed in a musical theme. At the conclusion of her musical effort she clings to the physician and begs to be saved from the terrible punishment about to befall her.

Episodes of exhilaration are also common in the catatonics; even the same patient may show periods of alternating depression and exaltation. Attacks of ecstatic excitement may interrupt periods of depression or, more commonly, periods of stupor. Emotional indifference is the ultimate state reached by the catatonic after the depression of the earlier phase has disappeared. The patient appears to be entirely contented or may exhibit a cheerful and happy disposition, irrespective of environmental conditions. The emotional state is usually not in

accord with the mental content and in this sense may be said to be conspicuously inconsistent. There is very commonly a condition of emotional irritability, which leads to impulsiveness, destruction and acts of violence. These, as will be seen later, are often carried out with total emotional indifference.

Train of Thought.—On account of the variegated picture presented by the catatonic, the flow of ideas and the character of the thought content will vary greatly. As previously noted, there is frequently a state of emotional depression accompanied by delusions of self-depreciation. In such instances there is usually the characteristic fragmentary mixture of depressive ideas with those expressing emotional indifference and for considerable time the language used may even, in the early phase of the disorder, present a fairly coherent train of ideas.

In states of catatonic stupor the patients are usually totally inaccessible to psychological examination, hence the train of thought cannot be followed. From examination of patients after they have emerged from the stuporous state, it would appear that the train of thought follows, as in the normal, the order of sensory experiences and doubtless there is little if any associative ideation. Furthermore, it is probable that single persistent ideas in some cases play a part in the maintenance of the catatonic state. A patient who had been lying in a state of apparent stupor with muscular rigidity, mutism and negative resistance, abruptly roused from his rigid condition for a brief period, said, "I'm on duty," and again lapsed into the stuporous state.

In catatonic excitement there is increased psychomotor activity which resembles the manic state from which it must be differentiated. The characteristic associated verbigeration is quite common. The flow of ideas is similar in character to the movements and is without purpose and consists of meaningless constructs of unfinished ideas and therefore without evidence of a guiding or goal idea. The train of thought may be influenced by external impressions, but not to the same extent as in the true manic; in fact, the dementia præcox patient appears not to give attention to the suggestions of others. Usually external stimuli make no impression.

Fixed ideas manifest themselves and are expressed in both speech and action. A patient otherwise mute and catatonic, who had a left brachial monoplegia, the result of a self-inflicted gunshot of the head, replied to all questions by saying "Amputate my left arm," "I am not well," "Shoot me instantly."

Frequently the flow of ideas is interrupted before the termination of an idea is reached, and as the mental deterioration advances the ideas expressed constitute a totally irrelevant collection of words—a "word salad," "*salade de mots*" (Forel), with the formation of new words or of neologisms, as already mentioned.

In spite of the retentiveness of memory and perceptive clearness for a long time preserved, there is ultimately marked dilapidation of thought, as all the thought processes undergo deterioration.

4. The Paranoid Types

Systematized delusional states in the adolescent have been described under many captions and by many observers. The *paranoïa originaïre* of Sander and the *délire chronique à évolution systématique* of Magnan were among the earlier types described. The questionable status of true paranoia is naturally reflected upon the clinical entity which is now denominated the paranoid type of dementia præcox and which has as its most conspicuous symptom delusion of a grandiose or persecutory type. It is, therefore, not strange that the paranoid state in the adolescent, or young adult, should present considerable difficulty in its differential diagnosis from true paranoia. In the eighth edition of Kraepelin's text-book the paranoid forms are divided into two groups: (1) *Dementia paranoides gravis.* This includes mental disorders, with a delusional content and a distinct disorder of behavior with emotional and volitional disorganization. (2) *Dementia paranoides mitis,* or hallucinatory deterioration. These cases, as the name implies, have as conspicuous symptoms persistent hallucinations and delusions. The term *mitis* is used to indicate that there is less damage to the individual personality and general behavior.

According to Kraepelin, the onset of the grave form is gradual in 63 per cent., and in 30 per cent. it is subacute. The sense falsifications are prominent and appear early in this group.

The paranoid forms of dementia præcox appear later in life than either the hebephrenic or the catatonic types; and the mental deterioration, which is one of the chief differential marks to separate paranoid dementia præcox from other paranoid states, is comparatively slow in its progress. The precocious dement of the paranoidal type presents the symptoms characteristic of dementia præcox in general, to which is added a delusional trend which has more or less appearance of systematization in its make-up. Careful study of the delusion content will show, however, that the systematization is very imperfect and often distinctly puerile in its lack of logic.

Mode of Onset.—The beginning of the disorder, like other types of dementia præcox, is often accompanied by subjective symptoms. The patient may complain of insomnia, general weakness, mental depression, lack of ambition and interest. A young school-teacher spoke of his charge being more than he could manage and that he did not have the grasp of his work that he thought he ought to have. He complained of hearing a voice which he thought was that of another teacher in the adjoining classroom. This condition persisted for a number of weeks until the annoyance became so great that he was obliged to tender his resignation. After such a premonitory phase the patient usually becomes restless, irritable, subject to outbursts of anger whenever corrected for his acts and later becomes more suspicious on account of the hallucinations, whereby his delusional pseudosystem grows. Any of the senses may be involved, but more commonly the patient

is annoyed by auditory hallucinations. He complains that he is watched wherever he goes, is insulted, annoyed, deprived of his liberty, threatened or maligned. The persecutory delusions are, however, of a distinctly disjointed kind and finally he reaches a point when he appeals to justice for protection, as an object of unfair treatment by the world. Following an indefinite period of excitement or a depressed emotional state and with hypochondriacal and persecutory delusions, often the disorder is marked by a grandiose phase. He becomes exalted in spirits, develops the idea that he is going to issue important inventions which will be of hitherto unknown value to the Government; that he is a person of great importance, never before known to his parents; that he has been endowed with divine qualities and that he has a great mission to carry on in the world. At this point the apparent system in the delusive trend becomes broken up and the ideas owe their changeability to the character of the hallucinations experienced. At about this time, usually a number of months after the onset of the disorder, there appear symptoms that give evidence of the dementia præcox character of the psychosis. The conduct of the patient shows distinct changes, such as the manner of speech, carriage, gesture and general conduct. The speech is generally marked by a tone of affectation, sentences are uttered in a commandatory tone or in whispers. With this change the patient is usually entirely absorbed in his delusive, but now disconnected, train of ideas, which often take on the character of mysticism. The hallucinatory experiences may gradually subside, and the patient settles down into a quiet phase of indifference, is inattentive to his environment, develops untidy and slovenly habits and has little to say except a few inconsequential stereotyped phrases.

It is following in the wake of the period of mental exaltation with grandiose ideas that the mental deterioration shows itself plainly. It is here also that the symptoms characteristic of dementia in general become manifest. Catatonic symptoms, including mannerisms, resistiveness, negativism, impulsiveness and stupor, are frequently present.

Symptoms.—*Hallucinations* are an early symptom and take a prominent position in the development of the attitude and reactions in general. Auditory sense falsification is the most common. The patient hears voices of persons maligning his character; they accuse him of being guilty of crimes, of being a masturbator and that he is the object of threats made by unseen persons. More rarely there are visual hallucinations in the form of faces on the bare walls or ceiling.

Tactile hallucinations are present at times in the form of burning sensations in various parts of the body; these are apt to occur in cases that are complicated by alcoholism. Hallucinations of taste and smell are not infrequently present, giving rise to the idea that poisonous powders or gases are thrown into the patient's room or that the food is contaminated. Consciousness is not clouded, and there is complete orientation in all phases. Memory is practically unaffected, except

in that there may be falsifications by reason of defective judgment and the sensory falsification.

Emotionally there is a change in the patient's attitude towards facts of environment. There may be periods of depression on account of the hallucinatory experiences, or the patient may become irritable and subject to angry outbursts. Commonly there is a phase of exaltation which is shown by expressed feelings of superiority and satisfaction in spite of the persecution which the patient believes prevails.

Judgment is profoundly affected, as is indicated by the impossible character of the delusive ideas which are usually expansive and commonly fantastic and colored with mysticism. Thus a patient who, in order to get away from his persecutors, traveled across the continent saw a light in the sky which followed him continuously. This was controlled by persons above who were tormenting him by throwing fire and acids on his body, destroying his flesh, breaking his bones. Headline advertisements and cartoons in the daily press all refer to him and the work of his persecutors who may be political enemies.

All the delusive ideas are usually given free expression by the patient, except in some instances when he believes that persons about him are fully instructed as he is. They write at length, describing their experiences, commonly illustrating the same by sketches and diagrams. Some patients adopt codes for writing their communications with the idea that their persecutors may not be able to read them, as in the following example.

7.5.20. 23.9.19.5.
g e t w i s e

2.5.6.15.18.5. 9. 23.15.21.12.4. 11.5.5.16. 1. 6.18.9.5.14.4. 1.
b e f o r e I w o u l d k e e p a f r i e n d a

3.15.14.20.18.15.12. 8.5.1.4. 3.8.9.5.6. 1.14.4. 3.15.14.20.18.15.12.
c o n t r o l h e a d c h i e f a n d c o n t r o l

15.23.14.5.18. 9.14. 20.15.18.20.21.18.5. 2.25. 8.15.12.4.9.14.7. 8.9.19.
o w n e r i n t o r t u r e b y h o l d i n g h i s

11.5.25. 1.19. 1. 6.18.9.5.14.4. 9. 23.15.21.12.4. 16.1.19.19. 8.9.19. 11.5.25.
k e y a s a f r i e n d I w o u l d p a s s h i s k e y

15.18. 13.21.18.4.5.18. 9.14. 4.5.3.5.14.3.25. 20.15. 20.8.5. 19.20.1.6.6. 15.6.
o r m u r d e r i n d e c e n c y t o t h e s t a f f o f

20.8.9.19. 18.9.14.7. 9. 8.1.22.5. 3.15.13.16.12.9.5.4. 23.9.20.8. 5.22.5.18.25.
t h i s r i n g I h a v e c o m p l i e d w i t h e v e r y

18.5.17.21.9.18.5.13.5.14.20. 15.14. 25.15.21.18. 7.9.21.5.14. 23.15.18.4. 1.14.4.
r e q u i r e m e n t o n y o u r g i u e n w o r d a n d

3.8.9.5.6. 8.15.23. 1.13. 9. 20.18.5.1.20.5.4. 25.15.21. 3.1.14. 5.14.4. 9.20.
c h i e f h o w a m I t r e a t e d y o u c a n e n d i t

1.14.4. 9. 23.1.14.20. 15.14.5. 23.1.25. 15.18. 20.8.5. 15.20.8.5.18. 20.8.5.
a n d I w a n t o n e w a y o r t h e o t h e r t h e

6.9.14.9.19.8. 19. 5.24.3.21.19.5. 6.18.1.14.11.14.5.19.19.
f i n i s h s e x c u s e f r a n k n e s s

For a time the delusive ideas may be more or less connected and orderly, but soon this is lost and the thoughts are such an incoherent collection of ideas that they can scarcely be understood.

Conduct is controlled by the hallucinatory experiences and the delusive content. There is marked restlessness, as a rule, sometimes mixed with agitation; the patients are often noisy, calling out, cursing their enemies. One patient sang loudly in order to drown the sounds of the false voices he heard. They perform peculiar movements to overcome morbid bodily sensations. One patient was obliged to go through numerous gyrations and bodily contortions before beginning to eat, otherwise his annoyers would so influence him as to interfere with the necessary movements in taking food.

Such actions have the appearance of mannerisms and stereotyped movements, but on account of their mental origin are in the strict sense movements of a volitional order. True mannerisms do develop but are apt to involve speech rather than general bodily movement. Coined words, neologisms and set phrases are repeatedly expressed by the patient. These patients become indolent, careless in habits and are unable to be occupied usefully for more than brief periods unless under constant supervision. In the graver cases such a course of the disorder may be fairly rapid and pass into a state of chronic deterioration after several months. More often, however, the course is slower and extends over a period of four or five years.

The milder cases run a more protracted course with less encroachment upon the personality. There are at times evidences of distinct cyclic exacerbations, in which are seen evidences of active hallucinations of either vision or hearing, giving rise to a general disturbed mental state. The patient may misinterpret facts, mistake persons for detectives who are watching him; sometimes new patients coming into the hospital, coincident with the hallucinatory outburst, are credited with being responsible for his annoyances. He may complain that his food is being interfered with and that he detects the taste of drugs in it. After a few weeks of such mental disturbance the active symptoms subside and the patient again settles down to his usual routine in the hospital life, apparently comfortable in mind and body, until in a few weeks or months later the episode is repeated.

The course of the disorder in the paranoid forms of dementia præcox is progressive; that is, it is not subject to remissions, as in the other forms of the disease. Mentally the patients live for years without much clouding of consciousness and with more or less alertness, yet unable to separate themselves mentally from their delusive ideas until a severer grade of deterioration sets in. Occasionally one meets with patients who will speak of their delusions as being not real, but the insight is not as true as it appears, but rather an artful device for the purpose of gaining the confidence of relatives in order to secure desired ends, especially for obtaining their discharge from the hospital.

The disorder lasts for many years, due to the fact that the deteriorating process is the slowest of all the types of dementia præcox.

Paraphrenia.—In the attempt to properly group some of the paranoid forms, Kraepelin separates a small group of cases from the dementia præcox group in the last edition of his text-book, because the principal disturbance lies in the intellectual realm. The patients do not present the emotional indifference which characterizes dementia præcox. Under paraphrenia, four subdivisions are recognized:

1. *Paraphrenia systematica,* characterized by its slow development with delusions of persecution, which ultimately become grandiose. Hallucinations and other sense falsifications form a conspicuous part of the picture. The disorder continues throughout the entire life of the individual.

2. *Paraphrenic expansiva,* which is said to occur chiefly in women, and is characterized by grandiose ideas and delusions and mental exaltation similar to the exalted phase of the manic-depressive psychoses. The disorder continues for many years, showing no evidence of deterioration or marked evidence of emotional indifference.

3. *Paraphrenia confabulans,* which shows little to distinguish it from the former group, but is marked by the presence of falsifications of memory upon the basis of which the foundations of the delusive trend rests.

4. *Paraphrenia phantastica* includes those cases formerly known as dementia paranoides. As the name implies, the mental state is characterized by the impossible content of the delusions and the absence of involvement of the emotional field.

Inasmuch as all of the forms of paraphrenia involve a course of long duration, the differentiation cannot be made early in the development of the disorder.

Treatment.—The treatment of the dementia præcox patient presents some of the most perplexing problems with which psychiatry has to deal. In the first place the onset of the psychoses frequently is not definitely characterized by symptoms which permit the prediction of what condition will have to be met, and one is therefore frequently taken unawares by the more or less abrupt development of a maniacal state, a depression or a condition of stupor. Any of these symptoms may be presented in any form of psychoses in an adolescent, so that at first it may be difficult to decide whether we are dealing with a psychoneurosis, a toxic exhaustive psychosis, one of the manic-depressive disorders or a typical case of dementia præcox in its incipiency.

The question of whether or not cases of true dementia præcox recover is still a disputable one and cannot well form a part of the present work. Suffice it to state that many patients presenting symptoms which seem to warrant at least a tentative diagnosis of dementia præcox appear to make good progress towards restoration. Every case of suspected dementia præcox should be approached with this in view

and treated accordingly. The question as to real recovery must await for its answer in some cases until the time when the patient has reached the period of mental and physical maturity.

The problems to be met are physical, mental and environmental. The young man or woman who breaks down during school life is usually poorly nourished and exhausted as the result of overwork (?) and lack of rest.

In mildly depressed cases the rest treatment need be but partial; that is, sixteen or eighteen hours out of the twenty-four hours are spent in bed.

As has already been stated, the causes of dementia præcox are nearly always multiple, so that contributing physical factors should be sought for in the general examination of the patient. It is in this class of adolescents that the characteristic præcox complex is dreaded, hence the patient should be thoroughly examined with the hope of eliciting some physical defect upon which to place some of the etiological burdens.

In many instances physical conditions are found which in themselves do not produce the symptoms met, but in an individual of the deviate type time furnishes a contributory element among the combined etiologic factors which it behooves us to remove, if possible, in order to help stem the storm. Among these factors may be mentioned such physical defects as malnutrition, anæmia, defective endocrine functions, focal infections, including tonsils, air sinuses, unnoticed teeth abscesses, impacted molars (usually the third), chronic intestinal stasis, the result of flexures and redundancies of the various portions of the colon, particularly the sigmoid. The latter may be regarded as physical anomalies which are accidental developmental defects which harmonize with the neuropathic predisposition, but nevertheless may be considered as offending factors and should be treated as such, giving the patient the benefit of the doubt.

In practical experience it often happens that the patient is not brought to the physician until the mental condition is such as to make the necessary examination difficult, if not impossible, for a time at least.

In most instances the patient is a proper subject for several weeks' rest in bed. Rest, food and elimination are the essential needs to be supplied at once. The alimentary canal has been neglected, the mouth unhygienic through lack of attention, supplying a rich flora of bacteria to aid in decomposition of food material ingested. A sluggish condition of the bowels is more often present than absent. The urinary output is often reduced and concentrated with an abnormally high acidity

In fact, we are not infrequently confronted with the same picture as met in the toxic exhaustive states and which calls for similar but less intensive treatment. In cases of excessive acidity the administration of alkalies by mouth and by bowel may prove beneficial.

Careful attention to the condition of the mouth from the standpoint of cleanliness is important. The frequent use of alkaline antiseptic lotions will serve to keep down putrefaction of retained food particles and thus minimize the chances of added infections. Not infrequently these patients do not swallow the saliva with the result that large amounts may be retained for hours at a time. Not only the bowels but the bladder often requires attention on account of the negativistic retention of both the urine and fæces. If the urine is retained, daily catheterization may be necessary. In spite of frequent colonic irrigation the fæces may become impacted.

The problem of feeding often becomes serious and requires mechanical interference. In some catatonics there is little difficulty in giving food, yet the patient may regurgitate all food as promptly as it is given.

This may be so persistent as to give rise to a condition of inanition to which the patient may succumb. In such instances it is better to feed the patient in small amounts, an ounce or two at a time, at frequent intervals. Sometimes the patient will retain in the stomach a day's feeding, only to regurgitate the whole amount at the time of the last feeding. Evidently in these cases the autonomic control of the gastric masculature is seriously at fault and portends a grave situation.

After the acute symptoms have subsided and the patient appears to have recovered, in a large degree at least, the treatment resolves itself largely into the matter of supplying the patient with an environment to which he is able to make adjustments. During the period which can be termed convalescence, the treatment is largely occupational and reconstructive. A definite period of work is prescribed for the patient, care being exercised to avoid crowding the patient and producing mental fatigue. Handwork is probably the best, selected from the arts and crafts. Daily exercise, partially in the open or entirely as circumstances may permit, must not be neglected. Regular hours of rest during the day and for retiring are important, as is the supervision of the diet and general body condition.

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CHAPTER V

CYCLOTHYMIC PSYCHOSES

(MANIC-DEPRESSIVE)

REACTION TYPES CHARACTERIZED BY A BENIGN QUANTITATIVE DISTURBANCE INVOLVING CHIEFLY THE EMOTIONAL SPHERE; CORRESPONDING MORE OR LESS WITH NORMAL REACTIONS, AND WITH A TENDENCY TO RECOVERY AND RECURRENCE.

In recent years the tendency has been to collect into one group the psychoses characterized chiefly by a state of mental exaltation formerly termed "mania" and those the principal symptom of which is mental depression, termed "melancholia." Of these classes there were formerly recognized acute and chronic mania, acute and chronic melancholia and "alternating" and "circular" forms of both classes in which mental exaltation and mental depression appear in the same patient in different phases of the same attack of mental disorder or as separate attacks.

As a matter of fact, it is a frequent experience of observation to note that many types of mental disorder present exalted phases and depressed phases, as may be seen in alcoholic psychoses, in paresis and other organic psychoses. It remained for Kraepelin, however, to point out the fact that a large group of psychoses, approximately 20 per cent. of hospital admissions, present symptoms of a depressive character and also of mental exaltation, or a mixture of both, occurring at variable intervals. The attacks may follow closely one upon the other, or periods of years may elapse between attacks.

The disorder fundamentally involves the emotional field, but without intellectual impairment, except in cases in which the intervals between attacks are so short as to give little or no opportunity for the exercise of normal mentality. These, however, are atypical forms to be considered later.

The reactions in the typical manic-depressive psychoses are not so patently pathological as in more malignant types of disorder, for example, dementia præcox, but represent a quantitative disturbance in the field of normal reaction tones, rather than a qualitative disorder, such as is seen in the psychoses which tend towards mental deterioration.

The manic-depressive psychoses include many grades of depression and excitement, varying from attacks in which the symptoms are but mild exaggerations of the patient's normal reaction type, to those of extreme excitement or of profound emotional depression.

As every emotional state in the normal individual tends to end in a volitional act, so do we find that accompanying the emotional disorders there is an involvement of the psychomotor processes. There are three of the mental fields involved indicated by (1) alteration of the emotional status, (2) alteration of the flow of ideas, (3) alteration of the rate of bodily activity.

These three divisions of mental activity, as in mental health, are subject to fluctuations above and below a hypothetical normal level, or within certain limits in an individual normal. The direction which the emotional fluctuations take forms the basis of the three typical subdivisions of the group:

1. The **manic** type, characterized by emotional exaltation, euphoria or emotional irritability, by an increased psychomotor activity and an increased rate of thought—flight of ideas.

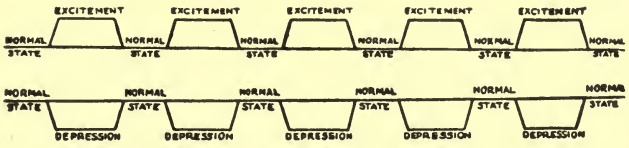
2. The **depressive** type, characterized by depression of the emotional tone, diminution or retardation of psychomotor activity and diminution of the rate of flow of ideas.

3. The **mixed** types characterized by a fusion of the components of excitement and depression in the same patient; namely a depressed emotional state, that is, reactions to stimuli in terms of mental discomfort, or with difficulty of thought, yet with psychomotor excess and rapidity of the flow of ideas.

This last subdivision includes cases which may present varied mixtures of disturbance of the emotional and psychomotor content.

The strong tendency for psychoses of this group to recur throughout the lifetime of the individual has given opportunity for observation of the variations which may arise in the order and character of the attacks.

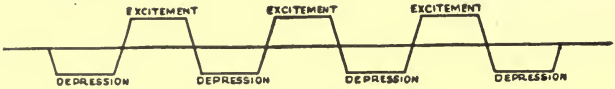
1. There may be (*a*) periodic attacks of the manic type or (*b*) periodically recurrent attacks of the depressive type.



2. The attacks may present alternating periods of excitement with periods of depression with or without an appreciable normal interval between the two phases.

3. The attacks may present cycles in which both excitement and depression appear as part of each attack, with a normal period between the attacks.

4. The circular form in which attacks of excitement and depression follow each other without intervals of normal mental state.



5. Finally there are forms in which there is no apparent regularity in the occurrence of attacks of depression or excitement or in mixed forms of attack.

Etiology.—The causal factors in the manic-depressive group of psychoses centre about an unmistakable yet not definite constitutional defect. This defect is indicated by a tendency to attacks of manic-depressive psychoses, dementia præcox or other mental disorders, not infrequently appearing in several generations of a family. Heredity may, therefore, be said to play an important part in at least 80 per cent. of the cases; in some instances the heredity is similar; that is, manic-depressive psychoses may appear in several generations and in different members of the same generation in a family. Individual mental make-up in some persons seems to furnish a personal predisposition; for example, a natural morbid depression or worrisome disposition with an inclination to habitually look upon the gloomy side of life; on the other hand, an excessively optimistic disposition characterized by a strong tendency to demonstrative outbursts of joy, temper or passion are not infrequently described as characterizing the potential manic-depressive patient. Hoch[1] refers to this type of personality in contrast with that of the "shut-in" type of the schizophrenic candidate.

Age.—There appears to be no age of selection for the appearance of the manic-depressive psychoses. The writer has observed them as early as twelve years and as late as the sixth decade. One patient, observed in five attacks, had the first attack at sixteen years—with regularly recurring attacks at intervals of about two years, each attack lasting ten or twelve weeks. These cases, of course, require considerable study in order to eliminate the possibility of mistaking the attacks for hebephrenic exacerbations.* Another patient who suffered her first attack in young womanhood was observed in a second attack at the age of sixty. The majority of cases appear in the first attack between the ages of twenty-five and forty years. Extraneous causal factors doubt-

* *Vide* the Manic-Depressive Dementia Præcox Problem.

less have an influence as precipitating elements in the etiology. In the case of the young man above mentioned a pneumonia with secondary empyema preceded an attack; in another an attack followed influenza; in another patient a fracture of the wrist in the first, a fracture of the ankle in the second instance were the immediate forerunners of the attacks. Stress or family discord, business disappointments and reverses are sometimes sufficient in some strongly predisposed persons to furnish situations to which adjustments cannot be made.

General physical reduction seems to be a contributing factor in some cases, which gives room for the question as to whether these cases do not properly belong to the somatic-disease group of psychoses. It is the coincidence of the latter group, with depression or excitement as the most prominent symptom, that justifies the opinion of some writers that a recognition of the manic-depressive group of psychoses should not be permitted to destroy the clinical importance of mania and melancholia as two distinct forms of disease.

General Symptomatology.—It may be said that the symptomatology of the manic-depressive psychoses broadly represents quantitative disturbances of the normal mental processes or products of those mental processes which are either diminished or increased in their functional activity. The reactions are abnormal in degree in both phases of the disorder, but are in strict accord with the emotional tone which prevails at the time. When there is an exaltation of the emotional tone, there is, as in the normal, an excess of psychomotor activity and an abnormally increased rate of flow of ideas; similarly, in states of depression, there is a morbid depression of the emotional tone with diminished psychomotor activity and retardation of the flow of ideas. Just as the normal individual thinks and acts in terms of his feelings, so the clinical picture of the manic-depressive patient indicates that the manner of his adjustments is consistent from the standpoint of the emotional tone.

Disturbances of Perception.—In both the manic and the depressive phases perception is often impaired; that is, percepts are incomplete and therefore imperfect, due largely to faulty attentive power, hence environmental facts are not clearly apprehended. In states of extreme excitement and in profound depression consciousness is likewise more or less clouded for the same reason; at the rate at which impressions are received there is not sufficient time for their assimilation, hence there may be disorientation for place and persons, which accounts for the patient calling strangers by familiar names. In milder forms there is no clouding of consciousness, and the patient is well oriented in the matter of all phases of his impressions.

True *hallucinations* of the senses are elicited with difficulty, and never do they form a conspicuous part of the symptomatology of the disorder, in either depressed or exalted cases. Illusions are common in both phases and are due to faulty attention to real percepts, with

consequent failure to gain clear perceptive experiences and, in a large measure, to disturbances of organic sensation. Some manics complain of hypersensitiveness to light, sounds and tactile stimuli; others complain of the reverse condition, a sense of imperfect vision, double vision, a feeling of heaviness, lifelessness, bodily oppression, difficulty in breathing and a vague sense of discomfort of the entire body. Very frequently the sensory disturbances are referred by the patient to the thorax and abdominal cavities and to the gastro-intestinal tract. In depressed cases, especially, the complaint is made that the body cavities are filled with solid material; that the lungs are filled so that the patient cannot breathe; that the throat is closed or paralyzed and swallowing is made impossible; the head feels empty or solid as a stone; the brain feels as if it were dried and loose in the skull. One patient marks with her finger on the parietal eminence the point to which her brain has shrunken. Common sensation is often markedly obtunded in both the manic and depressed cases. These patients may show little evidence of discomfort in connection with intense heat or cold or physical pain. The sense of fatigue in manics is frequently much impaired, while in depressives there is likely to be a constant feeling of weakness. One patient for years remarked daily that she was steadily growing weaker.

Emotion.—As has been emphasized, the fundamental disturbance in the manic-depressive psychoses implicates the emotional sphere. In the manic types there is an exaltation of the emotional tone expressed in terms of euphoria and an abnormal degree of happiness and irritability. The manic is apt to be jocose and witty; his remarks are quite pertinent and facetious. The normal inhibitory influence over the emotional reactions is unrestrained; in fact, he cannot avoid exhibiting his exalted feelings. In the same way he is easily roused to a state of anger from which he may be readily diverted, due to the ease with which his moods are changed. Periods of depression not infrequently precede the manic phase and also may appear for short intervals during the attack.

In depressed forms the emotional tone is one that indicates reaction to all stimuli in terms of mental discomfort; the patient presents the picture of sadness, anxiety, hopelessness, and not infrequently a state of fear exists. Some patients complain that they are unlike themselves; no one in the world was ever in the same condition; it is impossible for them to get well, yet they cannot die. The patients' surroundings to them seem changed, faces of relatives have changed; they have lost all feeling of affection for children; no interest in anything; in fact, say that they have no feelings at all.

Train of Thought.—In accordance with the emotional state, the flow of ideas is either increased, retarded or diminished. In the manic states the flow of ideas is increased. On account of the rapidity with which they arise as the result of external stimuli and chance associa-

tions it is difficult for the patient to maintain a definite train of thought, as the theme changes rapidly. Furthermore, the influence of increased passive attention forces the patient to give attention to every accidental stimulus, hence in conversation one sentence is scarcely ended before another is begun. The patient wanders far afield in his attempts to relate experiences—with the characteristic **circumstantiality** which accompanies the "flight of ideas."

In states of depression the antithesis of flight of ideas is seen in the retardation of thought. Thought seems actually difficult and efforts to collect ideas are painful to the patient. Much urging is necessary to evoke an expression of ideas on account of the need for the repetition of the initiating stimuli. In the mixed forms of depression there may be a flow of thought to which expression is not given on account of delusions, fear or anxiety. When an idea does arise it is apt to persist until by the same laborious process it is replaced by another idea. Single persistent ideas may become so fixed as to dominate the entire field of consciousness to the exclusion of other ideas—**hyperprosexia.**

Judgment—Delusion.—Judgment is more or less impaired in all phases of the disease. Delusions, as a rule, are not prominent in the manic states, as there is often insufficient opportunity for the formation of conclusions as a basis upon which to construct fixed delusive ideas. In some instances, when the flight of ideas abates and the euphoria still persists, there is developed a feeling of superiority to which may be added delusions of a persecutory character. Not infrequently the patient believes that he has been poisoned. Also in conditions in which there is more or less clouding of consciousness, yet insufficient to mask the emotional exaltation, distinctly grandiose ideas are developed which are more or less stable and persistent.

In the depressed phase of the manic-depressive disorders, delusive ideas form a conspicuous part of the symptomatology. These ideas develop out of the depressed emotional tone and are usually hypochondriacal, self-accusatory and persecutory. The ideas frequently refer to the bodily condition of the patient; he believes that he is to be subjected to further discomfort by supposed enemies, or is to be punished by the authorities for supposed wrongs, neglect or criminal acts. The depressed patient may acknowledge that he is not well, but usually lacks a clear insight on account of the belief that it is the neglect of himself or some duty that has been the cause of his unfortunate situation. He is devoid of hope; no one can help him and death is the only solution of the problem. He may realize that he is nervous, but attributes it to worry about his troubles.

Disturbances of memory do not appear as an important symptom. In fact, some manics remember with remarkable clearness the important incidents of the attack and after recovery the patient may explain in detail the reasons for many of his acts during the period of excitement. If the excitement has been intense, impressions are imperfectly

formed and memory is accordingly impaired for events covering that period. There is commonly a playful tendency to fabrication in which the patient may relate impossible experiences, from the telling of which he seems to derive pleasure.

In some depressed types memory shows a greater degree of impairment, which in all probability is due to diminished impressibility on account of weakened attentive power and also to the retardation of all thought processes. In other cases, especially those of the mixed depressions, memory is little, if any, impaired.

Volition and Behavior.—The manic types are characterized by psychomotor excess due to lack of control over volitional processes. As the emotions are unrestrained, every stimulus is accompanied by a strong tendency to impulsive action, which is usually carried into effect unless diverted by a second stimulus of greater intensity. The patient in a typical manic attack shows more or less constant activity, due to the ease with which stimuli give rise to motor response. These patients are busy, yet are able to accomplish little or nothing; before one act is completed another is begun. Continued flight of ideas produces uninterrupted activity, including articulate and written speech.

Commonly patients chatter for hours without ceasing, and at times shout at the limit of voice. They talk themselves hoarse and yet seem to show little or no signs of fatigue. Not uncommonly articulate speech activity is replaced by voluminous writing. Page after page of interrupted and disconnected ideas is turned out every day. Some of the ideas may be more or less coherent, but after a few lines are completed the ideas become broken up and often pass over into rhymes, without sense of connection, produced by association of ideas. The character of the writing is usually larger than the person's normal, and is apt to be largely flourished and heavily underscored and illustrated with diagrams and sketches (Fig. 73).

In depressed forms the reverse condition prevails. Action is slow and efforts are made with difficulty. In profound depression there is little or no activity, the patient sitting almost motionless for long periods. Speech is commonly absent on account of a poverty of ideas and the psychomotor retardation.

In mixed types there may be an increase of psychomotor activity and more or less constant moaning or repetition of phrases, yet without ability to enter into conversation on account of the pressure of activity and the mental stress.

1. The Manic Types.—On account of the fact that the severity of the attack is characterized by the degree of fluctuation above the individual emotional norm, the manic states are represented by their clinical types, which include *hypomania, acute mania* and *delirious mania,* to which a fourth is added, *chronic mania.* The fundamental symptoms, emotional exaltation, flight of ideas and psychomotor hyperactivity are prominent in all three grades of the manic phase of the disorder, but

may vary in intensity, and each of the symptoms may occur with varying degrees at different times in the same patient.

Hypomania.—As the term indicates, hypomania is the mildest form in which the manic state occurs; in fact, some cases represent so slight a deviation from the patient's normal mental make-up that to one not acquainted with the individual the question of the presence of an abnormal mental state is sometimes difficult to decide.

FIG. 73.—Patient's sketch. Pictorially illustrating mental activity.

Usually there are prodromes by which an approaching attack can be foretold by persons best acquainted with the patient. The prodromes are restlessness, irritability, insomnia and not infrequently mental depression, loss of interest and incapacity for work. After a few days or a week of initial symptoms the signs of mild mental exaltation appear. The patient now becomes more active, talkative, irritable and perhaps he appears mentally brighter than when in his normal state, but with the characteristic that he has no regard for the inconvenience to which he subjects other persons in the conduct of his activities.

Emotionally these patients are usually happy, good-natured and affable as long as their wishes are not obstructed; at times they are witty and in their humorous veins are prone to deal in sarcasm. When opposed in their plans or actions they are easily angered and resentful

towards their opposers, insistent upon wishes being carried out without delay and usually before one direction is carried out another is issued. On the whole the reactions indicate their impulsive character and the lack of control over the emotional impulses. Lack of the sense of fatigue gives the patient a feeling of buoyancy and of the ability to accomplish more than ever.

Train of Thought.—A continuously flowing stream of ideas is facilitated by the ease with which associations are formed which force themselves not only into the field of consciousness but which, on account of the absence of inhibition, also find expression in speech or other forms of action. On account of the emotional exaltation the patient is apt to be boastful and emphatic concerning the importance of his acts and desires to the exclusion of all others. The practical affairs of every-day life are insignificant compared with his schemes in business or other matters. He may propose to launch into new fields; the business man speaks of entering a profession, the professional man will start out on a literary or scientific career. An attorney-at-law decided that he would devote his time to writing a book on the "Monism of Science," because he saw in his mind's eye the relationships of all branches of science; he had formed theories of his own, the facts for which he was only surmising, but nevertheless knew that they were correct. His explanations for ideas and actions were always plausible.

The train of thought is often extremely rapid; in fact, more rapid than the ability to express ideas. One patient stated after his recovery that if it were possible to write all the ideas that went through his mind "they would fill volumes." The ideas are usually complete in themselves but nevertheless disconnected and ill-assorted. Inaccuracies in the statements made by the patients are often numerous, due to the inability to fully comprehend clearly impressions that do not gain the centre of the field of consciousness and cannot, on account of their position, be given full attention. In this sense when the excitement is at its height there may be more or less clouding of consciousness while some facts are keenly apprehended. This condition is more apt to be present in the typical mania.

Psychomotor hyperactivity is the most prominent feature of the disorder. The patient is under a more or less constant tension and therefore the pressure of activity compels him to be busy at something all the time. Always active, yet unable to accomplish anything in his usual pursuits, he shifts from one occupation to another. One patient who had spent many hours cutting out headlines and advertisements from a newspaper wrote the following message to his wife:

"Dear ———: I am too busy to spit. ———

E———"

In spite of the amount of work which the patient expects to accomplish, he is always easily diverted, is ever ready to discuss and expound his new theories and plans. He is extravagant and neglects the serious

matters of life for the sake of his ambitious plans. The patient gains pleasure from his exalted emotional tone and consequently his behavior reflects the fact; he feels more free than in his normal state; on account of the feeling of unrestraint he takes greater liberties with himself and with other persons. He often exceeds the bounds of moderation in eating, drinking and sexual relations. When admonished or restrained by relatives and friends he becomes angry, insolent and at times abusive. One of the conspicuous characteristics of the hypomanic is the shrewdness with which he justifies his acts with plausible explanations. Patients of this class are often impossible to control outside of hospitals and yet appear so normal that it is with difficulty that they are restrained in an institution, as they are apt to appeal to the courts for their liberty, and with the energy characteristic of the condition, pursue the matter with a reckless disregard for business or social consequences. Occasionally the patient is so plausible in the statements he makes in defence of his acts that he obtains the help of an ill-advised person who may champion his cause.

Mania.—This is the more typical form of the exalted phase of the manic-depressive psychoses, inasmuch as the external manifestations of the emotional disorder are more pronounced than in hypomanic states. There is a still greater flow of ideas and less reasoning process, hence ideas are almost instantly transferred into action as speech and bodily movements. There seems to be a veritable torrent of ideas and impressions to which vent is given by reason of the lack of an efficient inhibitory influence.

Perception.—Hallucinations, as already pointed out, are rare. Impressions are doubtless very vivid and intense. The very nature of the patient's mental state makes it difficult in some instances to decide whether true hallucinations are present or not. The consensus of opinion of many observers who have carefully investigated the subject is that the instances cited in which hallucinations were observed were the outcome of error in interpretation of the patient's symptoms.

Emotionally, the mental state is similar to that in hypomania but in a greatly exaggerated degree. There is extreme irritability, to which is added an exuberant happiness; there is present an ever-ready tendency to outbursts of anger at the slightest provocation, usually punctuated with profanity and maledictions. Interference with the patient's activities sometimes results in violent antagonism and in serious accident.

The train of thought in the typical mania consists of a more or less continuous, rapid flow of ideas which often gives the appearance of incoherence on account of the multiplicity of changes of subject. Upon close analysis, however, it will be observed that chance associations are almost instantly formed from stimuli to which the patient may seem not to give attention. A single sound or a fragment of conversation overheard by the patient is sufficient to momentarily shift the train of thought. There is an absence of any thought objective (goal idea); the

similarity of sound of a word with that of a word heard by the patient may be sufficient to direct the flow of ideas into a new channel. Furthermore, marked **distractibility** of attention acts as a factor in the production of the flight of ideas. Passive attention is here still more dominant than in the milder forms of manic states. It is impossible for the patient to actively give attention for a sufficient length of time to stimuli which would permit of a directed train of thought. Answers to questions may be given correctly, though briefly, as long as the attention can be held.

Psychomotor disturbance is a conspicuous symptom of the manic state. The patient is restless and noisy. If in bed he rolls, tosses and kicks the bed clothing about in an aimless manner; he chatters constantly or may shout, sing, harangue, laugh or cry; another patient walks almost ceaselessly, climbs, dances, pounds, claps his hands, assumes attitudes, and jumps about as if he were performing acrobatic feats.

The patient's behavior is conspicuous in its impulsive character. It is impossible for the patient to remain quiet except for brief intervals. Destructiveness is a common propensity; one patient states that she enjoys breaking dishes because she likes to hear the noise. Other patients destroy everything within reach; they tear clothing, bedding, break furniture, because they feel that they "must do it." Commonly the patient decorates herself with strips of torn clothing, ornaments her hair with bits of ribbon, paper or string, which have been collected. The personal habits are always careless, commonly untidy and often extremely unclean; they mix their food in an unsightly manner, smear their bodies and furniture, fill crevices in the wall with mixtures of food and filth.

On account of the great degree of exhilaration ideas are apt to be expansive in delusive notions, which are more or less constantly changing. In women there is often a mixture of persecutory and religious ideas which may continue for a time after the acute manifestations of the disorder have passed. These ideas are often the outcome of illusory experiences, which the patient may relate as dreams. One patient insisted for several weeks that she was no longer human but divine, which she had learned from a dream in which she saw the departed members of her family. Not infrequently manic patients acknowledge that their ideas are purely fabrications.

Men are more apt to assume exalted personal attitudes of a more materialistic character. They style themselves as prominent personages, military men, rulers and great philanthropists.

Physically the patient usually becomes reduced through lack of rest and sleep and insufficient food. Insomnia is practically always present and may persist for long periods. The patient is under too great pressure of activity to eat with any degree of regularity and consequently bolts his food. As the excitement subsides and the patient

is able to go out of doors and to eat with regularity, he adds to his weight.

There are no definite physical signs which may be said to belong to the psychosis. Commonly the pulse is rapid, face flushed, the reflexes heightened.

Delirious Mania.—The group of cases which are named delirious mania include those cases of the severest type of mania in which no causal basis can be found. In many instances the excitement is so intense as to preclude the possibility of making a satisfactory physical examination of the patient, so that the question always arises in such cases whether the psychoses belong to the manic-depressive or to the somatic disease group.

The distinctive differences between the delirious and the other types of the psychosis are of degree only. There seems to be an admixture of the features of true delirium with the characteristics of the manic. Sensory disturbance is marked, consciousness is clouded and more dream-like than in the preceding forms and colored by both depressed and heightened emotional reactions, which may change rapidly.

Fleeting depressive and expansive ideas are given expression and are associated with extreme flight of ideas and temporary total disorientation in all phases. There may be brief intervals when the patient seems more lucid and realizes that he is not at home, that persons about him are strangers. He is apt to call persons in attendance by familiar names. The emotional tone varies from one of comfort to discomfort and changes rapidly; one moment excessively happy and the next moment in the depths of despair on account of intense fear of impending calamity.

Psychomotor activity is greatest in this type of mania. The patient appears to have no realization of possible consequences or dangers to which he or others are exposed. He is extremely noisy, shouting, screaming, singing, praying, cursing, obscene in language and actions. On account of the extreme restlessness, the patient may be in danger of collapse from exhaustion. He strips himself of all covering, and, on account of the lessened sensibility to pain, he bruises and scratches himself by contact with furniture or bedspring, which he usually keeps bare.

Physically these patients usually become much reduced, as they take little food during the height of the attack. Insomnia is persistent. The circulation is accelerated and the pulse often weak and intermittent, on which account, if the myocardium is impaired, there is danger of physical exhaustion. The urine may be greatly diminished by reason of the low blood-pressure and is of high acid content.

Course and Prognosis.—On account of the severity of the symptoms and the danger of collapse from circulatory failure, the attack in favorable cases does not extend over many weeks. Usually within a month the excitement diminishes, sometimes within a fortnight. There

are apt to be residual symptoms, such as clouding of consciousness and confusion, or a delusional trend, from which it is difficult to detach the train of thought. Fatal cases terminate as the result of failure of the heart muscle, hypostatic pneumonia, pulmonary œdema or secondary infections. The graver manic states often appear in persons already physically reduced, but are also common in those who are apparently physically robust.

2. **Depressive Types.**—As in the manic types, the mental disturbance in the depressed cases affects the emotional tone, the train of thought and the psychomotor sphere. The fundamental symptoms are (1) emotional depression, (2) retardation of the train of thought, (3) diminution of psychomotor activity. The degree of severity with which these mental processes are involved varies greatly, as in the manic states, and gives rise to different grades of intensity of depression.

(a) Simple depression is characterized by a depressed emotional tone with slowness of the train of thought and without the formation of a delusional content. There is retardation of both thought and action, associated with mental depression. On account of the fact that the emotional disorder is not so patently altered, the term **simple retardation** is commonly applied to this group.

Symptoms.—In accord with the emotional tone, the patient thinks slowly and is very deliberate in all motor activity. Great effort is necessary for the patient to speak, act or think, hence the most prominent manifestation of the disorder is **inactivity.**

Disturbance of the *special senses* either as hallucination or illusion is not present. There is no clouding of consciousness. Attentive power is weak, hence the inability to be occupied in anything requiring continued thought. Orientation in all its phases is undisturbed. Emotionally there is a uniform depression, which in some cases is not manifested in terms of mental distress. The chief difficulty is manifested in the sluggishness of thought processes and consequently in the absence of speech. There is a poverty of ideas; patients complain that they have difficulty in thinking of what they want to say. They experience a sense of fatigue or exhaustion, hence they show little inclination to talk of their own initiative. When urged to answer questions, replies are given in almost inaudible tones. The patient, on account of the emotional depression, is unable to take interest in any of his accustomed activities. He complains of feeling despondent and hopeless—often preferring to be alone, idle and unmolested. He feels out of place; often says that he is not wanted in the company of others and sometimes gives expression to ideas of fear of impending disaster. He may speak of the fear of poverty and a general sense of personal inadequacy; he is entirely out of harmony with the environment and adjustment is impossible.

Judgment is impaired but not to such an extent as to give rise to delusion formation. There is usually considerable insight. The patient

may state that he has "lost his nerve"; that he cannot get hold of his mind. The course of the disorder usually extends over several months and terminates in recovery.

(b) Depression with Delusional Formation (Acute Depression). This form is characterized by a more pronounced depression of the emotional tone, with dependent delusion formation, by psychomotor retardation and by impeded thought action.

The onset sometimes is preceded by a mild state of mental exhilaration after a few days of which the depression becomes manifest.

Symptoms.—Hallucinations of the senses are not common but illusory disturbances are frequent, largely dependent upon imperfect perception or alteration of organic sensation. Patients often say that they see in the acts and language of others that they are not wanted. Consciousness is clear and all experiences attended to are apprehended without any difficulty. Orientation is not disordered, and memory is unimpaired.

Emotionally there is profound depression; a feeling of personal unworthiness and inadequacy is a conspicuous feature. Nihilistic ideas are a prominent mental product of the depressed emotional state. These patients feel that they are unworthy of attention, that they have lost their social rights, that they have committed unpardonable wrongs, that they have, through neglect, been responsible for the death of a relative. They are apt to take a retrospective view of life and regard all their lives as "thrown away." The element of fear is often paramount; they believe that on account of misdoings or neglect they are to be arrested, to be called to trial in court, to be imprisoned or executed for some crime. They regard their whole lives as mockeries, and that persons about them know of their shortcomings, are holding them up to scorn and are making fun of them. They feel that as the result of neglect others are made to suffer. One patient stated that every mouthful of food she took caused suffering on the part of members of her family. Others feel that they have been hopelessly abandoned; they have no home, no clothing, no money; that they are to be cast out into the streets to wander forever.

Delusions form a conspicuous part of the disorder and are in accord with the depression. Most of the ideas are hypochondriacal in character and refer to the body state. Patients state that they have no internal organs; that the bowels are helplessly clogged; that they cannot digest food because no excrement comes away; there is no passage to the stomach; they cannot swallow. Disturbance of the organic sensation may give rise to delusions of an impossible character. One patient stated that he felt as big as a Colossus; on another occasion only his head was alive; again that his bladder had burst, hence there was no way for him to pass fluids. Patients frequently state that their bodies are so changed that they will never die. One patient insisted that she had contracted leprosy and

had infected the entire world. Frequently ideas of personal inadequacy and poverty dominate the patient's mind. He declares in the midst of abundance that he has no money, that he has no clothing, the family is going to starve and that someone will come to take the home from him and his dependents. Delusions of self-accusation are very frequent in occurrence and form a prominent part of the mental disorder; on this account the patient is in constant distress because of the belief that some terrible punishment, such as being burned or buried alive, is in store for him: a punishment such as never was before inflicted upon anyone. Patients accuse themselves of having been the greatest

FIG. 74.—A remarkable case of catatonic rigidity. Supported only at the shoulders and feet, the body is completely suspended in midair.

of sinners, or neglectful of health, parents or children. Their misdeeds have been of such serious character as to affect the entire world.

States of stupor commonly develop during which there is a degree of clouding of consciousness, although insufficient to exclude from consciousness the delusive trend. These often assume impossible characteristics. Patients state that they are removed from the earth and flying through space; that they are eternally removed from all contact with human beings; that they themselves are no longer human but have become changed, "lower than the vilest animal." Surroundings to them seem to have been entirely changed, everything is a mockery, a sham, nothing seems natural or familiar; sometimes the patient insists that he is dead, unable to move a limb, and is able only very slowly to articulate, so great is the motor retardation.

In some instances the delusive ideas assume a negative phase; the hospital in which the patient is placed is not a hospital but only an establishment made to appear so, with the purpose of doing away with the patient; the other patients are persons who are there only for the purpose of tantalizing and mimicking; food is prepared attractively only to entice the patient to eat that which it is already known will harm

him; letters written to the patient are forgeries. In other cases the ideas are given a nihilistic color; the patient has no head, no stomach; there is no food, no air; one patient persistently urged to be put out of the window as she was being suffocated for want of air.

On account of the psychomotor retardation, the patient lies motionless in bed, requires to be fed by hand, pays no attention to his physical wants; at times will lie in a stuporous state superficially resembling catatonia, on account of the marked resistance and negativistic reaction to stimuli and the tendency to assume peculiar and awkward bodily attitudes. These patients do not present the other characteristics of catatonia, such as verbigeration, stereotype speech and action. When the state of fear is marked, the patient may repeatedly groan or moan (Fig. 74).

Psychomotor retardation is a striking characteristic of the psychosis. The depression implicates all the functions of the mechanism of adjustment, consequently there is retardation of thought and action. In some cases both mental and physical inactivity is so marked that the patients lie in bed without giving heed to their surroundings or giving attention to their physical wants. Stimuli fail to arouse response except under persistent repetition of their application.

All reactions are slow and movements made with difficulty. Commonly the patient does not speak, but mumbles a few unintelligible sounds in reply to questions.

Physical signs present are indicative of the depressed status of the *nervous system as a whole* and characterized by dysfunction. There is, as a rule, a general physical reduction shown by a loss of weight, pallor or sallowness of the skin and sometimes a symptomatic anæmia. The skin is either dry and harsh or moist, cold and clammy. The secretions are often diminished, the salivary and lachrymal glands greatly diminished in activity. One patient noted an absence of the production of the ceruminous glands. The appetite is poor and anorexia may be present. The tongue is heavily coated and constipation is the rule. The patient complains of discomfort in the epigastric region, on which account there is often a strong antipathy for taking food, which is intensified by delusive ideas. The circulation is sluggish, although the pulse may be regular and the blood-pressure raised.

Respirations are likewise slow and shallow, not infrequently marked by deep sighing, as if to accelerate the oxidation process. The urinary output is diminished and the amount of solids reduced. Coincident physical disturbances, not essentially a part of the symptom-complex, are frequently met as complications. Insomnia is persistent; on account of the fact that the patients are disturbed by dreams, they have the feeling of having been continuously awake; hence they often insist that they do not sleep at all. It is not uncommon for patients to make the statement that they "never sleep."

3. **Mixed Types.**—In the mixed phases of the manic-depressive psychoses several subvarieties occur in various combinations of symptoms of emotional depression and emotional exaltation; retardation of thought and ideas; psychomotor excess and psychomotor retardation.

The most important of these have been termed:

(1) *Maniacal stupor,* characterized by emotional exaltation, retardation of the flow of thought and diminished psychomotor activity.

(2) *Agitated depression,* characterized by profound emotional depression, marked flight of ideas and great psychomotor activity.

(3) *Unproductive mania,* characterized by emotional exaltation, increased psychomotor activity, but with marked retardation of the flow of ideas.

(4) *Depression with flight of ideas,* indicated by emotional retardation of the flow of ideas but with psychomotor excess.

(5) *Depression with flight of ideas,* indicated by emotional depression, psychomotor retardation, but with increased rate of thought—flight of ideas.

(6) *Akinetic mania,* characterized by emotional exaltation and flight of ideas, but with marked diminution of psychomotor activity.

Course and Prognosis.—The tendency in the average attack of a manic-depressive is towards recovery, but with a strong likelihood of recurrence. The duration of the attack varies greatly in individuals, from a few days to several months, usually six months or less. Many cases present an ascending curve of development of the attack covering a period of several weeks, followed by a stationary period of excitement or depression, as the case may be, lasting several months, and later a gradual decline marked by the disappearance of symptoms and a slow return to convalescence.

Macdonald [2] has recently concluded from his study of the subject of prognosis in the manic-depressive psychoses that the outcome is more favorable in the depressed type, the intervals being longer and the tendency to recurrence less. Manic attacks first occurring at forty or later are unfavorable, there being a greater tendency towards chronicity as is the case with depressives after fifty.

The constitutional nature of the defect which gives rise to the favorable soil for the development of the psychosis speaks for recurrence. The greater the constitutional predisposition, the more frequent the attacks and the shorter the intervals.

The intervals between attacks are likely to grow progressively shorter in proportion to the number of attacks. The more frequent the attacks the greater the liability to mental deterioration.

On the whole, it may be said that the course of a manic attack is less prolonged than that of the depressive attack, also that mania has a greater tendency than depression to become chronic (Tanzi).

Involutional Melancholia.—The term melancholia in recent years, under the influence of the Kraepelinian point of view, was for a time

limited in its application to the group of psychoses, occurring in the period of functional decline, characterized by a state of emotional depression, giving rise to mental suffering; by psychomotor activity and an attitude of anxiety or fear and without disturbance of consciousness and the receptive processes. These patients are not deprived of any of the mental processes but of their control. Kraepelin now regards the involution melancholias as inseparable from the manic-depressive psychoses.[3]

Etiology.—The symptom-complex termed melancholia is a product of the period of involution, commonly appearing at the time of the climacteric, in women somewhat earlier, between forty and fifty years, and in men somewhat later, usually after fifty years. Heredity plays a part but to a less extent than in the manic-depressive psychoses. About 60 per cent. of the cases give positive histories of familial neuropathy and psychopathy.

Physical signs of approaching senility, perhaps prematurely, are common in a large proportion of the cases, which fact has led to the grouping of the involutional melancholias under the "presenile" psychoses.

Mental stress, shock and worry are found in the histories of the patients in this group probably more often than in any other. Doubtless persons predisposed neuropathically and approaching the period of involution are more seriously affected by psychic shocks than are those whose visceral and vascular degenerative changes have not begun. In comparison by analogy, it is not uncommon to observe the fact that arteriosclerotics who have begun to exhibit signs of serious vascular changes seem to advance rapidly in mental deterioration after profound emotional shock.

The onset of the disorder in melancholia is usually preceded by prodromal signs in the form of insomnia, lack of power of thought concentration, mental fatigue, irritability, crying spells, various feelings of head discomfort, lightness, heaviness, pain, pressure or dizziness. There is usually loss of weight, lack of desire for food and a feeling of general weakness.

Often rather suddenly developed mental depression, to which are added very pronounced delusions of a self-accusatory character, usually appears with "ideas of negation" and fear of impending calamity. Accompanying the depression and the delusive trends are unmistakable signs of mental distress and marked motor agitation. In some instances the element of fear is not pronounced and consequently the agitation is less marked. The development of ideas of sinfulness gives rise to numerous self-accusatory and hopeless delusive ideas.

Symptoms.—Perception for the greater part is not impaired. True hallucinations are not present; illusory experiences are not uncommon, although these disturbances are more properly classed among disorders of judgment rather than as true sensory disturbance. Thus, a patient hearing the pounding of mechanics working says that they

are building a scaffold for her execution. Disturbances of bodily (organic) sensation such as are described under the depressed types of the manic-depressive psychoses form a basis for delusive trends.

Emotionally there is profound depression, to which is added the element of fear. In spite of the emotional depression, the patients may be diverted for a few moments and induced to smile, or even go so far as to give notice to humorous events. Thus a patient whose pulse was being taken by the physician declared that she had no pulse and no blood in her body, and, suddenly observing another patient who was noted for her pugnacity, she said with a smile, "Doctor, I dare you to feel her pulse," and immediately lapsed into her depression. In some cases the degree of anxiety is so great that the patient is in a constant state of dread of approaching disaster.

The **train of thought** when expressed is characteristically centred about the patient's self. She is the one who is responsible for the terrible conditions which exist and the calamity which is to befall her, her family, the community or the entire world. One patient incessantly repeats for hours, "My God, it is impossible." During her more quiet periods, when questioned, she says that she is "responsible for all the deaths in the world." Although many of the delusive ideas expressed refer to other individuals, they originate in a central idea of personal unworthiness and sinfulness.

So firmly rooted is the idea that he is deserving of punishment, the patient fully expects that each night is to be the last; that in the morning he is to be shot, or to be tortured by some horrible means. In some patients the train of thought appears at first sight to be retarded, while, in reality, ideas are not given expression because of fear arising from the belief that if they speak they will make their punishment more severe or that they will cause others to suffer. This has been termed **delusional control**; not infrequently patients do not speak of their fears and beliefs because they feel that other persons already know of them.

Judgment is markedly impaired, as indicated by the disturbed train of thought; delusions are prominent and arise on the basis of the depressed emotional tone.

Most conspicuous are delusions of self-accusation and ideas which are the result of anxiety and fear. Commonly the patient, as in the manic-depressive types, strikes upon some indiscretion of youth which in the patient's mind grows in its importance and gravity and becomes modified to suit the depressed emotional tone. Similarly, other events in the patient's life are recalled as the starting point of the "life of sin." One patient stated that when a young man he was suddenly stricken and thrown to the ground. While on the ground he heard the voice of God saying, "Follow me." This he attempted to do, but found that he could not move. On account of the fact that he did not "obey the call," his soul was damned to be eternally lost.

Much of the melancholic reasoning is of this sort and shows the

marked defects of judgment. Patients observe accounts in the daily newspapers—which they refer to themselves as indicating that their misdeeds for which they are soon to undergo punishment are being published widecast. Many patients refer to commonplace happenings as indicating their despicable position; actions of persons unconcerned are especially designed to attract the patients' attention in order to remind them of their fate; their children are to be tortured or killed or their families disgraced forever. Patients commonly express the fear that they will be taken away and put to death or "buried in the bottomless pit."

Occasionally one meets with a persecutory delusional trend. One patient persisted in the belief that he was to be smothered in a box, in order that his enemies might destroy the evidence that they had irreparably destroyed his body by poisonous substances which had been put in his food for a consideration upon the authority of the Federal Government.

Some cases may show distinct paranoidal trends associated with emotional depression. These patients are fearful and anxious; they will not talk for fear of being heard through the aid of mechanical listening devices and thus further incriminate themselves. Hypochondriacal and nihilistic delusive ideas are almost always present; their bodies have been changed; faces are disfigured by cancerous growths; they cannot digest food; their organs are dried and shrunken; there is no remnant of a human being left, "the hands transformed into claws."

Insight is always present in some degree. Early in the course of the disorder patients express the fear that they are going to "lose their minds"; that there is no hope for their recovery; that they have no control of their thoughts; and all affection for family has been lost; the world has no attraction for them. In spite of the degree of insight present, the patient is unable to see the fallaciousness of his beliefs and even impossible statements in regard to the delusive ideas.

Volition and Conduct.—Psychomotor activity is greatly increased. The patient constantly paces the floor, wrings her hands, strikes her head or pulls her hair. She cries, moans or calls out for help. One patient throws herself on the floor and begs to be shot, because she is worthless; another patient asks to be given poison; a third begs to be saved from the hands of those outside waiting for her. The tendency to self-injury is stronger in melancholia than any other type of depression. Suicidal attempts may be the outcome of a "command of conscience" or an impulsive act or as the result of an effort to escape mental suffering or supposed impending punishment.

Some patients seem to have no recollection of their suicidal attempts, while others acknowledge freely their inability to resist the impulse. These patients wander about aimlessly from place to place; they cannot sit or lie still for more than brief periods; they are unable to interest

themselves in any occupation or diversion; although they may be induced to do some sort of handwork, they persistently declare their inability to accomplish anything.

Refusal of food is a common occurrence which usually is for a definite reason. Frequently this is based upon delusive ideas in regard to the digestive apparatus; the belief that the stomach is filled with accumulated materials, or that the throat is occluded, that there is no stomach to receive food. One patient refused food on the ground that as the result of a fractured rib which injured the lung there was produced a communication between the œsophagus and the lung, into which he feared the food would pass. The patient quite willingly allowed a stomach tube to be passed in order to be sure of delivering the food in the right place. Many patients refuse food because they wish to starve to death, or because they are unworthy, or because they will deprive others of food. Some instances of refusal of food are the result of the belief that the food is contaminated with filth or that it contains poison. One patient who required mechanical feeding for months could not take food because each article of diet suggested the flesh of some member of her family.

In general it may be said that on account of the total absorption of the train of thought in the ideas of unworthiness the patient is usually careless in habits and personal attention is neglected. In periods of agitation, patients often tear their clothing, twist their garments; others pick the skin on the face, arms and fingers, bite and tear the nails and hair.

Treatment.—The treatment of the manic-depressive psychoses may be considered from the standpoint of prophylaxis and that of the treatment of the attack.

Prophylaxis.—As all patients who suffer from attacks of mental disorder of this group are strongly predisposed it is obvious that any measures which may be of use as counteracting factors should be employed.

If a patient has suffered from a previous attack, it is important to determine, if possible, what were the contributing factors in his environment in order that they may be eliminated as further possible influences. The amount of mental and physical work, the effect of home influences of a disturbing character, the general health of the patient and similar possible exciting factors must be carefully considered and steps taken to remove such conditions. These factors, because of their very nature, are most difficult to control in many instances because of the fact that the patient's normal make-up is such as to bring about the exciting causes. A vicious circle is thus established, which calls for the application of tactful ministrations in the highest sense of the term and, therefore, demands of the medical adviser his very best judgment and ability, if he hopes to successfully meet the situation. If the patient is constitutionally unable to make

adjustments to his environment, as is the real situation in many instances, the environment must be altered in order to come nearer to the possibilities of the patient. Each patient presents an individual problem which should be carefully studied and the ways and means adopted according to the merits of the case.

Treatment of the Attack.—Some patients suffer attacks of excitement or depression every so often, which seem to run a more or less definite course, irrespective of the kind of treatment or even whether treated or not. On this account there has been a tendency to regard the attacks as self-limited and that the need for any particular treatment is practically nil. This therapeutic nihilism has in recent years been slowly disappearing as the result of the study of individual patients, and separating the cases in which the extrinsic causal factors are more nearly equal in importance to the intrinsic factors, from those cases in which the constitutional instability is practically the sole operating cause.

In all cases it is important to remove the patient from the influence of the conditions under which the psychosis developed in order to remove, if possible, the effect of the exciting causes.

Manic Attacks.—In the hypomanic attacks it is often difficult to bring about a change of environment for the reason that the patient regards himself as in perfect health and also his friends and business associates may fail to recognize the presence of an abnormal mental state. It is a difficult problem in such instances to secure for the patient the needed rest and protection from his own exertions and misdirected efforts. The manic patient usually does not get sufficient sleep, is too busy to take proper and sufficient food, neglects his personal needs, is inclined towards excesses in eating, drinking and sexual habits. It is the milder form of manic attack which calls for the greatest amount of tact and vigilance, so difficult to combine, in order to curb the patient's actions without his being aware that it is done.

In the frankly manical attacks attempts at control are of necessity more positive, yet the value of tact as a measure for combating the tendency to antagonism by the excited patient cannot be underestimated.

Physical restraint of the patient's bodily activities should not be employed except in instances in which it is absolutely unavoidable. For controlling the psychomotor activity and as a measure to induce sleep, the prolonged bath is of signal advantage and first in importance as a therapeutic measure. In hospital equipment the baths are especially built for the purpose and designed so as to allow the patient to lie at full length in the tub. The temperature of the bath should be maintained at 96°–98° F., the water being constantly changed by a continuous flow, regulated so that the intake and outflow are uniformly adjusted. It is well that the patient's body be supported upon a canvas hammock fastened to the sides of the tub. The patient should *not be mechanically restrained* while in the tub. One who is so dis-

turbed as to require to be restrained in the bath is not likely to receive much benefit by the treatment except the cleansing effect. Furthermore, the procedure is dangerous on account of the possibility of the failure of the cold water supply and the chance of the patient being scalded before he could be gotten out of the bath.

A sheet of double thickness or a blanket may be thrown across the tub to prevent cooling the surface water too rapidly. The patient's head should be supported by an air pillow or invalid cushion and cold water should be applied to the head to guard against cerebral vasodilation.

The length of time for the continuation of the bath should be regulated by the condition of the patient. Should the excitement be increased the patient should be removed for the time and a trial made later. Just as some normal persons are made wakeful by an evening warm bath, so the excitement of some manics is aggravated by the prolonged bath. It is well to make the duration of the bath gradually longer each day, beginning with one-half hour and increasing to one hour the next and two hours the third, if beneficial results are obtained, so that the patient eventually spends three or four hours a day in the tub. Needless to say, constant attendance upon the patient while in the bath is imperative. The nurse should be provided with a hand bath thermometer to check the water temperature at frequent intervals in order not to depend upon the reliability of any temperature regulating device.

The patient should be dried by wrapping him in a warm sheet without rubbing and put to bed in a darkened quiet room.

Where the specially constructed continuous bath apparatus is not available, good results may be obtained by the use of the ordinary tub bath with the disadvantage, however, that it requires more constant attention to the flow and temperature of the water.

The Wet Pack.—Next to the continuous bath, the wet pack is an important sedative measure for employment in manic conditions. The pack consists in the application of a sheet wrung out of water at a temperature of 65° to 70° F. applied to the unclothed body of the patient and held in place by an enveloping blanket. At the same time, cold compresses are applied to the patient's head and frequently renewed. If the reaction is favorable, a moderate glow will be noticed in the face, followed by perspiration. If signs of lividity are apparent and a cold perspiration makes its appearance it may be concluded that the pack is not beneficial but is contraindicated. The patient may be kept in the pack from three-quarters of an hour to two or three hours. Longer duration for the pack is of doubtful benefit.

The question of drug sedation is an important one in every active manic case. The use of powerful sedatives which amounts to chemical restraint is steadily growing more in disfavor for the reason that it has a double ill effect; its clouding effect upon consciousness helps to make the patient more difficult to control as he emerges from the

effects of the drug, and the inhibitory influence upon the secretory mechanisms makes the use of such remedies as hyocine and morphin a real disadvantage in the manic states. Hypnotics are advantageous in many instances. Paraldehyde is perhaps the least harmful, but is objectionable on account of its pungent taste and the fact that its elimination by the respiratory organs causes some patients annoyance by its continued after-taste for nearly twenty-four hours. Furthermore, care must be exercised lest a paraldehyde habit become established. Veronal and trional either singly or combined seven and one-half grains of each may be employed occasionally in order to secure a night's rest for the patient after a day of activity. No one hypnotic should be used for any length of time. The use of opium and its derivatives is to be avoided except only in cases of emergency, for reasons stated above.

The pressure of activity which is so marked usually is well met by providing some means for the patient's occupation, whether useful or not. One patient may be absorbed by so trivial an occupation as making designs by perforating a sheet of paper with a pin; another by letter-writing; another by sorting picture cards. By such means a patient may amuse himself for hours. As the pressure of activity subsides some simple, useful task may be provided under the direction of an instructor if necessary.

In the declining phase of the attack the patient may show signs of fatigue, which often is an indication of the approach of convalescence.

At this period rest is important and caution should be observed in order not to overtax the patient mentally or physically.

As soon as possible the patient should spend the greater part of his time out of doors and moderate exercise employed with the addition of such tonic treatment as may be called for by the general condition. Throughout the attack, attention should be given to the elimination and diet.

Depressive Attacks.—Depressive types of the disorder commonly call for more careful attention to the physical condition of the patient on account of the depressed state of all the nervous functions. As in states of exhaustion from other causes, rest in bed is of prime importance and should be enforced part of each day at least.

Insomnia is commonly a troublesome symptom and in some instances must be treated with hypnotics. For the same reasons stated with reference to manic states it is well to avoid the use of hypnotics as far as possible. Depressed patients readily form the habit of depending upon sleeping potions or powders. In states of stupor contributory toxæmic factors should be sought for and treated as indicated by eliminative measures.

The necessity of regular feeding makes it an important therapeutic measure and often adds a serious problem on account of the stuporous condition of the patient or because his refusal of food

for delusive reasons necessitates forced feeding which is called for more frequently in depressed states than in any of the other psychoses. In an occasional case it is only necessary to make an exhibition of the feeding tube in the presence of the patient in order to induce the patient to take food. Many patients, on account of firmly fixed beliefs, resist strongly all attempts at feeding. In such cases the employment of a soft rubber nasal feeding tube is the safest procedure. With a No. 20, French scale, tube well lubricated with glycerine jelly, entrance is made into the naris which shows by examination the less amount of obstruction by deviation of the septum or other hypertrophies. Keeping the tube parallel with the floor of the nasal chamber the tube is passed gently backward until the posterior wall of the pharynx is felt at the tip of the tube, when with a slight pressure the tube is directed into the pharynx, which for an instant may produce a reflex resistance with more or less gagging. If this point is quickly passed, this discomfort is but momentary. Should a choking sensation be produced, together with the sound of air rushing through the tube, it will be apparent that the tube has entered the larynx at the moment of the first spasmodic reflex, instead of entering the pharynx. The tube should be withdrawn under such conditions and the procedure repeated. When the tube has reached the lower part of the œsophagus a faint clicking sound can be heard, especially if the patient can be induced to swallow. A few drops of water may be allowed to flow into the tube as a test to indicate that the tube is in the œsophagus.

Patients in profound stupor may not respond with the usual spasmodic reflex when the tube enters the larynx, hence extreme caution may be required in such cases.

For such feedings the preparation must be liquid and may be made of milk and raw eggs, two eggs to one pint of milk, peptonized milk, expressed beef-juice, thin gruels or porridge, broths, varied in amount and variety as the state of the patient's nutrition demands. Two feedings daily at least are necessary if the patient is not taking food. Care should be taken to add sufficient water to the feeding or just before and after feeding, in such cases in which the patient is not taking water. It is also a good plan to add a raw fruit juice and sugar at least once daily. In cases of marked resistance there may be regurgitation of food either by deliberate force or reflexly. In such cases, it may be necessary to employ lavage before each feeding and to feed smaller quantities at more frequent intervals.

Next to the maintenance of the patient's nutrition the most difficult problem in the treatment of the depressed patient is that of securing sufficient sleep. Commonly insomnia is the outcome of insufficient food, and when this is corrected the symptom may become ameliorated. It is important to determine, if possible, why the patient does not sleep before resorting to the use of hypnotics. Equally important is the determination, if possible, of how much the patient does sleep. It is not

uncommon to hear patients who sleep a part of each night declare that they do not sleep at all. As a matter of fact, they get short naps from which they are easily wakened; they are apt to be disturbed by dreams which leave the impression upon the patient that he has not slept at all.

Before resorting to the use of drugs to induce sleep, other measures should be first employed. Make sure that the patient is not wakeful at night on account of the fact that he sleeps during the day; also see that the patient is not too tired to sleep because of lack of rest during the day. Individual peculiarities of the patient must be taken into consideration as in health; some patients cannot sleep if the room is dark; others are kept awake by a light in the room. Needless to say, quiet is an essential in order that stimuli may be excluded from consciousness. As stated by Maudsley, "One sense goes to sleep after another," of these the sense of hearing is the last.

The tepid or warm bath, not over 100° F., followed by a hot drink, should be tried at first. If hypnotics are employed, there should be care in their selection for the particular case and the dosage should not be gauged with the idea of producing a full night's sleep at first. Going to sleep is a habit which may be for the time lost to the patient, and, therefore, there should be an opportunity for the recultivation of the habit by the patient himself which cannot easily be done if the use of hypnotics is carried too far. In other words, the patient who has suffered much from insomnia must relearn how to go to sleep.

Among the drugs usually employed it may be well to begin with the bromides, either singly or in combination, fifteen or twenty grains to the dose. The strontium salt seems preferable if a single salt is used on account of the fact that it has less of an irritating effect upon the gastric mucosa.

Next to the bromides, paraldehyde, as already mentioned, has less depressing effect than the other hypnotics but it also has the distinct disadvantage that it is very apt to give rise to habit formation. The unpleasant odor and taste are also objections to its employment for sensitive patients. As the action of paraldehyde is usually quite prompt it should not be given until the patient has retired. Two drachms may be given in an aromatic vehicle or with glycerine and water or with tincture of cardamom.

Chloral is a good hypnotic, but must be used with caution on account of its depressant effect, and also on account of the danger of habit promotion. The powder of veronal, trional and sulphonal may be used to advantage either in combination or singly on alternate nights. Needless to say, it is not wise to repeat the use of any one hypnotic for many successive nights. It must not be forgotten that the gradual decrease in the dosage of the hypnotic may have to be resorted to in cases of patients who have been taking sleeping medicine for long periods. The judicious use of *placebo* powders and potions will sometimes clear up the question of the real need for the use of hypnotics.

The fact that in many cases of mental depression there is a tendency to self-injury and destruction in order to avoid a continuance of mental pain makes the treatment of this condition a matter of constant vigilance, in addition to all other measures. Some depressed patients pass through an entire attack and recover without giving any clue to the fact that they have entertained thoughts of suicide. It is to be doubted whether very many patients during an attack escape without having thoughts in that direction, even though they may not be given expression. In some cases there may be no indication of the presence of the tendency until the patient actually makes an attempt.

The potential suicide, and every depressed patient should be regarded as such until unquestionably proved to be otherwise, should be watched uninterruptedly day and night, although it is not well to let the patient know the reason for the constant attendance of a nurse. If one attempt has been made by the patient there should be no relaxation of vigilance until it is determined that full recovery has taken place. A patient seemingly well advanced in convalescence and apparently in the best of spirits may be seized by an overwhelming impulse to take his life, which may prove successful when least expected.

Attention to the functions of elimination is usually of more importance in depressed states than in manic states for the reason that the functions controlled by the vegetative nervous mechanism are affected in the general depression of nervous function. Constipation is the rule in the average patient in this group. On account of the prominent part played by ideas of negation in the patient's mental life, his word cannot be depended upon as a guide to the condition of his bowels or the amount of food he has taken or in the matter of sleep. Daily observation of the number and character of the bowel movements is therefore necessary. The use of cathartics, like that of hypnotics, may get to be a habit; that is, the intestinal musculature, which has lost much of its tone, requires re-education and help to resume its normal reactivity. On this account care should be observed not to overdistend the bowel by too frequent and too copious amounts of enema fluid. Intestinal flushing is far preferable to the injection of large amounts of water with the idea of waiting for an expulsive response from the intestinal musculature. Cathartics employed should be reduced in their dosage as soon as possible. The drop-method of administration of fluid extract of Cascara sagrada with gradual reduction can be advantageously employed.

In states of stuporous depression the bladder condition must be watched to avoid distension. In every case of depression in which recovery takes place there is a time when mental therapy is of greatest value. Encouragement and mental stimulation may seem of no avail and the physician and nurse may almost reach the point of despair of ever making any impression upon the patient when, unwarned, the psychological moment may arrive at which the patient, stimulated by

the hopeful attitude of his adviser, may make an abrupt turn towards recovery.

Care should be exerted in order not to fatigue the patient mentally by insisting upon too early occupation entailing continued mental effort. A simple occupation of a diverting character is of value.

During convalescence some occupation entirely new to the patient, such as may be selected from the numerous art and craft occupations, will serve to divert the patient's mind into wholesome channels and lead to the development of new interests. At this period the patient should be treated on general medical principles, with tonics, exercise and reconstructive methods.

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CHAPTER VI

THE DEMENTIA PRÆCOX—MANIC-DEPRESSIVE PROBLEM

GENERAL SURVEY—ETIOLOGIC FACTORS—SYMPTOMATOLOGY

In the attempt to draw conclusions in regard to the causal agents operative in the production of a given abnormal reaction type one is obliged in the ultimate to reduce our knowledge to comparatively simple terms, which may be said to include three fundamental groups of factors: (1) The biogenetic factors dependent upon defects of development, either structural or functional; (2) disturbances of function brought about by toxic agents, either exogenous or endogenous; (3) organic neuronic changes, occurring either as primary disintegration processes or structural changes secondary to pathologic conditions in non-neuronic structures.

The most important question, in reference to the etiology of psychoses, resolves itself into the matter of determining which of the above factors is the chief agent in any given case.

It is commonly not a difficult task to decide when mental symptoms are the accompaniment and probable result of coarse changes in the nervous structures. When one attempts, however, to explain histologic changes which seem to occur with a certain degree of constancy in brains that grossly appear normal, the problem becomes more complex. It has been demonstrated that in hallucinatory cases, regarded as dementia præcox, cell changes occur in the temporo-sphenoidal gyri and in the parietal cortex in the brains of patients exhibiting catatonic symptoms.[1] This opens the discussion of the subject of the organic nature of dementia præcox and includes the question of whether the histological changes are "incidental," or rather belong to the "agenetic" or "aplastic" type of defect. In any event there is yet much to be said by the neuropathologist on this phase of the subject.

We have come to agree, largely as the result of the lessons taught by biology, that the causal factor, designated by such terms as "degeneracy," "psychopathic tendency," "neuropathic disposition," "constitutional inferiority," or other similar expression, is a **negative** rather than an active agent. It represents an **absence** of something, which means inability to carry on function in a normal manner, as is indicated by the fact that one individual having the greater deficit in a given direction will require less of an exciting factor in order to bring about a condition of abnormal function.

The greatest difficulty begins, however, when we attempt to estimate how much, etiologically, is due to inherent defect, and how much to factors outside of the nervous system.

The dementia præcox-manic-depressive problem deals with mental disorders which cannot be shown by any means now known to be primarily the result of disturbances of any part or parts of the soma. We must exclude, therefore, all mental states accompanying severe pain; all fever deliria and deliria of intoxication, due to infection or endogenous toxins and to exhaustion; uremia, gout and diabetes; intoxications due to exogenous toxins; simple depressions accompanying gastro-intestinal or other visceral dysfunctions; the mental disorders of the epileptic and the general paretic; the psycho-sensory and psychomotor disturbances of cerebral arteriosclerosis, and the disorders of deficient and excessive activity of the thyroid, pituitary and other ductless bodies.

In other words, after eliminating the psychoses, which may be the result of bodily disturbances, there remains a large proportion of our patients, the most perplexing problems in the field—the so-called *biogenetic psychoses.* These include psychoses, the causes of which are unknown, and concerning which the investigator is led into various speculative fields in the hope of being rewarded with the privilege of placing them in the category of definite toxic or organic psychoses.

The question of classification naturally increases in importance on account of the difficulty of its solution and because it concerns so great a number of most difficult problems.

The proposition to be solved requires an estimate of the probable outcome of the psychosis and may be stated in two parts: (1) The patient may emerge from the acute phase of his disorder with a demission of symptoms, but with a certain amount of mental defect and the likelihood of suffering later an exacerbation and ultimate deterioration amounting to imbecility. (2) The psychosis may be of a more benign type, running its course and terminating in recovery, thus allowing the patient to resume his position in the world, but with an almost certain chance of recurrence, especially if he is obliged to be subjected to the stress and strain of an average lifetime.

The question involves, therefore, the differentiation of the groups of psychoses which have been tentatively called **dementia præcox and manic-depressive psychoses.**

On account of the unsettled ground upon which our conception of these complexes is founded, rather than any change in the character of the disorders, there has been in recent years a tendency to shift patients from one group to the other, according to whether it is considered warranted by the clinical picture presented. In Kraepelin's reports the dementia præcox patients have been falling in number and the manic-depressive accordingly increasing.

There is considerable difference of opinion as to the details of what makes for dementia præcox and what for manic-depressive psychoses. Most authorities agree, however, that the term dementia præcox includes the psychoses which appear prior to mental maturity (early in

some and much later in others), with a tendency to permanent mental defect in the long run, but which may follow a chronic course, may be divided into attacks, or may improve or stop at any stage, but never with restoration to absolute mental health.

Manic-depressive psychoses are regarded as typical when characterized by an attack consisting of a depressed, an exalted or a mixed phase, but they also include all possible variations of these types of *emotional* disorder. With exaltation of emotional tone, rapidity of thought and action in the one phase and with depression of the emotional sphere, retardation of thought and action in the other phase, we have the extremes of a hypothetical emotional norm. These phases represent more or less the attitude of the individual towards his environment and *differ in degree only* from the manner of adjustment made by normal persons. The reactions which occur in both the depressed and the exalted phases are, from the patient's standpoint, in accord with environmental circumstances, although apparently not justifiable at the time. The reactions are *pathologic in degree but not in kind.*

It is not proposed to discuss here the question as to whether the psychoses above mentioned are entities, but rather the question of clinically separating the two groups of reactions early enough to permit of prognostication, before the disorder has assumed definite characteristics of chronicity.

The subject may be considered, from the standpoint of etiology, as far as experience has taught us, and, from the symptomatologic point of view, as the present-day standards direct.

Etiologic Factors.—The psychoses under discussion occur with greatest frequency in neuropathic families. To say that 50 per cent. of the cases furnish definite data in this respect will be a low estimate in dementia præcox, and the percentage is 70 per cent. to 80 per cent. in the manic-depressive.

From the standpoint of heredity, therefore, we are not aided in the matter of differentiation of the two psychoses, unless we are able to show that there is a difference in kind in these defective heritages. The difference may be anatomical in both instances, which remains to be shown; it may be functional, which seems quite probable. Biologists tell us that in the organization of the germ plasm there are certain characteristics, structural and functional, whose "differential causes" are in the germ and which appear in the offspring. Also that the "sum total of those qualities which is caused by this organization constitutes heritage" (Conklin). This still is inadequate, for the reason already stated, that it is the absence of normal factors that makes up the neuropathic condition.

Taking it for granted that the groups of psychoses under discussion require an unusual nervous mechanism for their production, a consideration of the matter in the light of the present topic may prove of interest.

As already pointed out, there has been a tendency to consider certain

psychoses as consisting of mental phenomena of the same nature and marked by deviations along the same line, as the personal peculiarities which formed the natural make-up of the patient before the beginning of the psychosis, and, furthermore, that the psychosis is a further development or continuation of that personal peculiarity. Magnan and Sander taught that doctrine in their "primary" and "original" paranoias. The question in such instances is whether or not the psychosis is colored by the personality (Hoch). In respect to dementia præcox, this phase of the matter has received much attention (Bleuler, Meyer, Hoch) and is regarded as of great importance from the standpoint of prognosis.[2]

The gist of the recent discussion of the biogenetic factors in the development of these groups of psychoses is that the diagnosis and prognosis differentially involve not so much the estimation of the severity of the symptoms and their effect upon the individual, but rather the nature of the mental peculiarities of the individual and the reaction type.

Symptomatology.—By a comparison of the symptoms in the two reaction types there are several points which appear pertinent.

Hallucination can be regarded as fundamental in dementia præcox. Kraepelin in the eighth edition of his text-book gives an important place to sense falsification in seven of the eight subdivisions of the complex. For the production of normal sensory experiences there are required (1) an intact sensory ending (receptor), (2) an intact conduction path, (3) an intact receptive centre. False sensory experiences are the equivalent of normal sensory experiences, as far as the reaction of the patient is concerned; if this be admitted, some interference with the function of the perceptive sphere must follow the reception of stimuli at the central end. The view held by Esquirol that hallucinations are ideas intensified and projected externally is no longer tenable in the light of the above statement.

Assuming that it is necessary to prove the existence of hallucinations in dementia præcox, it is important to bear in mind that it is not always an easy matter to determine whether this symptom is present or absent, for example, to distinguish true hallucinations from pseudohallucinations (psychosensory), called forth by real sensory stimuli. The stimuli produced by a shadow or a sound may give rise to a second sensory experience which might at first sight be considered as a real hallucinatory phenomenon.

Real sensory disturbances dependent upon organic visceral disorders are of frequent occurrence; thus, actual disorder of the gastrointestinal tract or a nasopharyngeal catarrh may be responsible for gustatory sensations which, on account of the patient's attitude, lead to the refusal of food on the ground that it contains "poison" or "filth." A patient with unilateral sciatic paræsthesia interprets the numbness and tingling of the affected leg in terms "electric currents" and "vi-

brating machines." None of these examples can properly be interpreted as an hallucination of the sense involved. The presence of hallucinations once settled upon, may later have to be reconsidered on the ground that, upon closely questioning the patient, the "voice" that is heard is in reality found to be the patient's thought.

True hallucinations involve only sensory processes and are independent of thought. Gross organic cerebral disease, which is excluded from the categories of disorder under discussion, can usually be readily eliminated; for example, a patient with a homonymous hemianopsia experienced one-sided visual hallucinations in the blind portion of the visual field; another patient with a cerebral monoparesis of the right arm and loss of stereognostic perception hears the voice of a man in his head. On account of the patently organic character of such symptoms differentiation would have to be made upon theoretic ground only.

In manic-depressive psychoses sensory disturbances are undoubtedly present. These are found upon close examination to be of the psychosensory type already referred to, depending upon the content of thought at the moment of experience or upon accidental, real impressions misinterpreted. They are fundamentally illusory in type. The changeable character of the sensory disturbance is also a fundamental peculiarity of the manic-depressive states. Manics may develop mental attacks due to somatic conditions (toxæmia) in which hallucinatory phenomena occur.

Whether pure, mentally uncomplicated, depressed states occur in the adolescent cannot adequately be discussed here, but the experience of many observers favors the view that purely functional types do exist. The matter of differentiation in some cases must be delayed on account of the fact that the initial phase of the disorder in many cases of dementia præcox, especially in the catatonic type, is characterized by depression without symptoms sufficiently definite for differentiation until late in the course of the disorder.

One of the oldest recorded classes of mental disorder among the semi-modern groupings of mental disease pictures is the "agitated melancholia," or "melancholia with delirium and ideas of negation," the so-called "mixed types" of manic-depressive psychoses. In such patients the dominating ideas are commonly the outgrowth of real sensory disturbances which might readily be mistaken for hallucinations. Frequently the delusions are based upon paræsthesias or disturbed organic sensations, which account for the patient's belief that changes have taken place in his body. The patient who says, "What are those people doing to me?" is not to be credited with hallucinations of hearing, as further investigation reveals the fact that he believes his body to be solid, as the result of the food he has eaten. His original (digestive) discomfort, which caused the anorexia and his refusal of food, is aggravated by taking food, and his defective judgment is responsible for the conclusion that unseen persons are causing his distress.

This class of patients commonly present symptoms also found in dementia præcox; for example, catatonic rigidity, stupor and excitement; resistance, negativism and mutism; but verbigeration, mannerisms and stereotypy, however, are not observed. Toxicity seems to be at the bottom of the condition, as indicated by accompanying somatic conditions. These patients frequently recover after long periods and furnish some of our most brilliant examples of the fact.

Dementia præcox is described by Kraepelin as having as its characteristic and fundamental symptoms an affection of the emotional sphere. One of the earliest manifestations is the deterioration which takes place in this direction. The depressions and exaltations apparent in dementia præcox are characterized by their inconsistency and appear as accessory symptoms.[3]

The manic-like features in dementia præcox are sudden, impulsive, incoherent and are not in accordance with circumstances; the depressed states are often profound, but are "subject to sudden and severe changes" (Kraepelin). Some patients show no emotional reactions, appearing emotionally neutral; others exhibit reactions that are not in accordance with experience. In some instances we frequently find that one experience may be accompanied by intense reactions, and another may give rise to no reaction. Suddenly appearing depression, especially of abrupt onset, with mutism, resistance and refusal of food, must not be regarded as necessarily belonging to the dementia præcox group.

Manic-depressive psychoses, already referred to as seemingly exaggerations of normal mental traits, differing only in degree, are preeminently emotional in fundament.

The elevation or depression is more or less uniform, notably so in comparison with that of the precocious dement. There is in the manic a distinct incoördination between the conceptual and the affective states, so that reactions are in direct accordance with the emotional tone.

Train of Thought.—The mind of the dementia præcox patient has been described as characterized by an ataxia between the conceptual and emotional activities (Stransky). Just as from the standpoint of emotion we observe a lack of stability or irrelevant reaction to experience, so do we find that ideas which actually reach the volitional field are really made up of fragments of thoughts put together to form new ideas. There is actually a poverty of ideas on account of the lack of material, in spite of the fact that perception is not primarily impaired. Furthermore, intense sensory experiences (hallucinations) are quite certain to control the flow of ideas and thus add to the incongruity of the train of thought. Accidental happenings often seem to influence the content of thought, but in a minor degree, on account of the defective power of attention.

Among manic-depressives, in the exalted phase, the flow of ideas

seems to go on in an uninterrupted stream, independent of sensory impressions. Whether this is true or not, one cannot tell positively, for the reason that the observer cannot experience the sensory impressions of the patient. There is one thing certain: that the ideas of the manic are always in the foreground and may at any time become tinged with accidental impressions. This seems partly to be due to the readiness with which he reacts to every real sensory experience. With the depressed cases we have to separate the psychomotor retardation from the "blocking" which is found so marked in dementia præcox.

Judgment—Delusion.—In most cases of dementia præcox there is at some time a suggestion at least of delusion. The mere presence of this symptom is of much less importance than is the character of the delusive ideas, whether frankly expressed or not. Delusions are in this disorder either an outcome of the patient's original intelligence defect, continued and intensified, or the direct effect of sense falsification. The character of the delusions has been described by Kraepelin, who designated them as characterized by their "bizarre form." They are often hypochondriacal in content and are an expression of the altered bodily feeling (cœnesthesia) usually expressed (indicated) by the patient as a feeling of strangeness.

It is usually associated with the belief that outside influences are responsible for these sensations. In spite of the direct relation between hallucinations and the thought content and delusion formation, there is a paradoxical lack of coherence when we take the patient's total mental state into account. The intellectual defect, of course, is responsible for the impossible character of the delusions.

In manic-depressive states which are apt to be confused with dementia præcox, especially the depressed and mixed types, we may find a badly warped judgment, but one that is consistently so. The depressed emotional tone dominates the situation and the conclusions reached are in harmony. All impressions received are followed by reactions in terms of discomfort, and the delusions present are the outgrowth of the emotional state.

Volition and Action.—It has been stated that the fundamental symptom of dementia præcox is "stolidity of conduct," and that the mental state of the patient is not so clearly indicated by what he says as by what he does (Tanzi).

The aimless excitement, impulsiveness and meaningless movements constitute the typical picture. There is an apparent contradictory attitude which is more or less constantly maintained, and in which the patient's thoughts are not faithfully carried. In the depressed dementia præcox patient with suicidal tendencies, we find that the attempts have been the direct effect of hallucinations, commonly a command.

In manic-depressive states we have the actions controlled as is judgment by the emotional exaltation or depression and they are therefore consistent. The dementia-præcox, manic-depressive problem ap-

pears to resolve itself into that which develops upon an inherently defective foundation. One is a fundamentally *qualitative* disturbance, the other *quantitative*. The dementia præcox patients present an original defect, which is intensified by some as yet unknown operative cause. The manic-depressives represent an altered quantity in reaction without a change in kind. Success in establishing the difference in diagnosis between these two psychoses will depend upon the possibility of separating the two types of reaction.

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CHAPTER VII

THE PSYCHONEUROSES
HYSTERIA, PSYCHASTHENIA AND NEURASTHENIC STATES

REACTION TYPES GENERALLY REGARDED AS OF PSYCHOGENIC ORIGIN AND WITHOUT DEFINITE DEMONSTRABLE PHYSICAL SUBSTRATUM

Hysteria.—Although hysteria is a disorder of mental origin, the subject cannot be exhaustively treated in a work limited to the scope of the present volume. It will, therefore, be practicable only to discuss this affection from the point of view of the psychiatrist and the interest which the study of the malady presents from the standpoint of a pathological type of reaction, in some respects interfering as seriously with the individual's adjustment as do many of the true psychoses.

To define hysteria adequately is to describe it with reference to the mental and physical phenomena which constitute its clinical picture. For the purpose of the present discussion, it will be necessary to consider the position occupied by hysteria in neurology and psychiatry with the description of the accompanying mental states, together with some of the physical signs and stigmata. The present-day interest shown in the subject was first stimulated by the researches of Charcot and his pupils, Gilles de la Tourette, Richet, and more recently by Janet, Babinski, Freud and his followers.

The subject of hysteria has undergone considerable revision since Babinski in 1908 presented his views upon the subject at the *Société de Neurologie* of Paris, to which reference will be made later in this chapter.

Hysteria may be said to manifest itself by anomalous reactions which may be present in one form or another from an early period of life, and which may be varied and apparently so lacking in cogency as to seem to defy all attempts at systematic arrangement of the symptoms and associated phenomena. There are, however, certain facts which present themselves with such constancy that there remains little doubt that, despite the varied clinical pictures presented by the disorder, there are certain fundamental principles which may be considered as a basis for their study.

Naturally these principles are derived from pathological psychology and physiology, but chiefly from the former, as the aim of this discussion is intended to point out.

Two factors are paramount in their importance from the standpoint of the genesis of the symptoms of hysteria: (1) The symptoms are

evoked from the emotional sphere and represent the reaction or the attitude and attempt at adjustment on the part of the individual. (2) They may be caused to appear and to disappear by taking advantage of an inherent suggestibility on the part of the patient, as in the production of one of the mental states allied to hypnosis.

Numerous definitions of hysteria have been offered and all of them are more or less inadequate, including the statement of Babinski that "a phenomenon is hysterical when it can be produced through suggestion and cured by persuasion." [1] This latter definition, of course, assumes the psychic origin of the disorder, but gives no intimation regarding the nature of the malady.

Babinski insists upon the necessity of the presence of certain stigmata in order that one may conclude that the condition under question is hysteria. The stigmata referred to are convulsive attacks, somnambulism, delirium, paralyses, contractures, tremors; choreiform movements, usually rhythmical, disturbances of phonation and respiration; disorders of sensibility shown in anæsthesia and hyperæsthesia; sensorial anomalies and disturbances of the bladder.

Concerning the symptoms which can be excluded from hysteria, Babinski says: "Suggestion cannot abolish or exaggerate tendon reflexes or cause disturbances of the pupillary reflexes or the cutaneous reflexes; at most, suggestion can only render examination of these phenomena difficult, or place obstacles in the way which might mislead the novice, but which the experienced neurologist would overcome; suggestion cannot induce vasomotor, secretory or trophic disorder, and it alone cannot induce hemorrhage anuria, albuminuria or fever."

On account of his belief in the above-stated cause and method of treatment of these affections, Babinski proposed the name "pithiatism," from the Greek words, meaning "persuasion" and "cure." Janet emphasizes the importance of ideas in the so-called hysterical accidents; in fact, "with hystericals," states Janet, "ideas have a greater importance and, above all, a greater bodily action than with the normal man." Janet is content with retaining only the first part of Babinski's statement, namely that *hysteria is defined by suggestion,* meaning that it is the effect of a too-powerful idea acting on the body in an abnormal manner. The suggestion, as Babinski maintains, is not regarded solely as an external factor operating upon susceptible persons, but it is often autopsychic in origin.

One of the peculiarities concerning some hysterical symptoms is the fact that they may exist without the patient's knowledge, as has been pointed out by Janet, to indicate the psychic origin of the symptoms. This was well illustrated in a patient who was anæsthetic as the result of an injury to the median nerve, and at the same time was found to suffer from a hemianæsthesia of the opposite side of the body of which condition she was not aware.

The most striking of the modern explanations of the genesis of

hysterical symptoms is based upon Babinski's dictum, namely, that the anæsthesias, for example, are the result of suggestion produced by the examining physician. This statement is controverted by the fact, already stated, that patients may have anæsthesias without knowing that they exist and are not, therefore, revealed except by examination. It is true, however, that repeated examination is apt to give rise to symptoms through suggestion if great care is not observed in this direction.

Furthermore, it is important to note that the areas of anæsthesia do not conform to any definite anatomical distribution of nerves. On the contrary, the anæsthesia of an extremity often stops abruptly, as would the upper limit of a stocking or glove; the anæsthesia may involve only a segment of an extremity which also is contrary to anatomical facts. In the same way do the paralyses appear with entire disregard for anatomical distribution of the innervation of the muscles involved.

The modern conception of the study of hysteria is, according to Janet, first of all, to endeavor to find some fundamental features which give to the disorder a degree of **unity**, the problem which concerns the so-called hysterical stigmata.

Both Janet and Babinski have pointed out that the examination of the patient may result in bringing about either an occurrence or disappearance of an anæsthesia, for example, and that among the patients who have not been examined the anæsthesias are rarer. The fundamental fact—the *stigma*—is, as already indicated, **suggestion.** The suggestion assumes the form of an idea in which, as Janet states, "instead of confining themselves to thinking the object, they seem to see it in reality or hear it. They conduct themselves before our eyes like individuals who have perceptions and not ideas; they reply to imaginary words; their facial expression is that of a person who hears." Furthermore, what these patients see and hear may be so vivid "that it seems completely to efface the normal vision of things that surround them."

Just as the palsies, anæsthesias and other somatic hysterical disturbances often imperfectly resemble similar physical signs of organic disease, so are the mental symptoms of hysterical origin incomplete representations of true psychoses.

Concerning the mechanism which produces symptoms, be they mental, motor, sensory or somatic, there has not been an adequate explanation in either Babinski's or Janet's theories. The chief distinction between the two theories lies in the difference in the points of view with regard to the importance of suggestion. Janet regards the suggestibility as dependent upon another factor, while Babinski holds that suggestion is the fundamental factor.

Janet believes that, in order that suggestion may have its full play, there must be an absence of all ideas antagonistic to the suggestion. Thus suggestibility is the result of a mental state allied to, if not identical with, absent-mindedness or amnesia, which Janet regards as

second in importance to suggestibility. Furthermore, the ease with which one symptom disappears only to be replaced by another—**a transfer or an equivalent**—is a characteristic.

Finally, the general statement with which Janet summarizes the situation places the responsibility upon "retraction of the field of personal consciousness"; that is, impressions gain sufficient importance so as to leave their effect upon a secondary consciousness, a mental state in which patients can be made to walk, talk and act in a manner unknown to themselves. That the fundamental state is a "moral weakness consisting in the lack of power on the part of the feeble subject, to gather and condense his psychological phenomena, and assimilate them to his personality."

To Freud must be given the credit of starting a school of thought which has aroused a widespread interest in a very few years. His doctrines have been wholly accepted by some and rejected *in toto* by others.

As already stated under the consideration of the "subconscious," Freud's studies began with the subject of hysteria, but have later been extended to the study of the psychoses and psychoneuroses.

Freud's doctrine requires the acceptance of the conception of the subconscious or unconscious psychical processes (see page 110).

The all important factor is the "complex," which is capable of giving rise to ideas, acting as a force controlling the conscious train of thought, although the individual may not be aware of the nature of the complex. Furthermore, a state of mental conflict is necessary by the presence in the mind of at least two opposing complexes, giving rise to a state of unpleasant emotional tension. The conflict must be settled either by the mind relinquishing or modifying one of the complexes, so that the incompatibility ceases to exist. In some cases the method of solution of the situation is a pathological one and gives rise to morbid symptoms, as are found occurring in hysteria and the psychoneuroses.

By the processes of repression and censure the ideas may be kept out of the conscious level of the mind, but nevertheless may have an affect upon the individual's reactions, especially when one of the complexes succeeds in "eluding the censure" and appears in consciousness not as the original complex but as a representative which is not recognizable to the patient. The mode by which this complex (regarded originally by Freud as a "wish") can be gratified constitutes the hysterical symptom.

According to the Freudian doctrine, it must suffice to state here that the hysterical patient is made the object of the activity of repressed complexes concerning the events in the past life of the individual and that the expression of the repressed complexes gives rise to the symptoms of the disorder.

Etiology.—Hysteria seems to furnish one of the best examples of an inherited morbid tendency. If not inherited, it is certainly acquired by association with morbid examples. Not a few observers hold that

the typical attacks of "grand hysteria" at the Salpêtrière were the outcome of an educational and more or less orderly arrangement of the manifestations of ordinary hysteria.

Although perhaps habitually associated with the female sex on account of the origin of the term hysteria (ὑστέρα), the uterus, the disorder does occur much more frequently in women than in men; commonly it affects males prior to adolescence. On account of the admixture of hysterical phenomena it is sometimes difficult to differentiate the catatonic type of dementia præcox from hysteria. In males past adolescence traumatic hysteria is the most common type. At least, it must be said, hysteria is an outgrowth from an inborn neuropathy and depends for its development upon extrinsic factors which act as exciting factors or give rise to suggestion. On account of the natural make-up of the individual, the reactions are those of an inordinate character, whether it be to pleasurable or painful stimuli and their accompanying emotional states.

In individuals of neuropathic potential, exciting factors, such as physical illness or a traumatism, which in itself may be comparatively slight, but in which the mental shock is considerable, may be the immediate agents in the production of hysterical manifestations.

It is not intended to describe here the classical picture of the attack of grand hysteria; for this the reader must be referred to the masterly descriptions in standard works on neuropsychiatry. The mental state accompanying the attack, however, requires attention.

Symptoms.—The attack, apart from the motor and convulsive phenomena, often resembles a delirium. It is generally preceded by prodromes of a few hours or a day or more, during which the patient is depressed, irritable, easily angered or frightened and is inclined to be unsocial and seclusive. Sometimes this period may present moderate degrees of excitability or mild exaltation, with alternate laughter and weeping. This may be followed by the convulsive type of attack, the hysterical delirium or a somnambulistic state.

In the delirious form the patient seems to hear voices or see visions to which she reacts in a dramatic fashion. Commonly these quasi-deliria, which are more accurately somnambulisms, according to Janet, are re-enactments of dramatic episodes in the patient's life, and he states that "it is easy to verify the assertion that this crisis is in fact an ensemble of emotional manifestation." The very common emotional reactions are those of fear, sometimes anger, sometimes grief.

According to the ideational material woven into the fabric, Janet terms the attacks monideic and polyideic somnambulisms.

The Hysterical Mental Status.—Janet has emphasized that the psychical stigma of the hysterical is a state of *absent-mindedness,* which paves the way for suggestibility. Suggestibility is furthermore favored by the plasticity of the emotional tone of the individual. An essential for the foundation of the hysterical character is emotional instability.

Tanzi states, "It might be more correctly said that there is an affective ataxia." It is on account of the changeability, inconsistency and contradictory type of emotive reaction that the hysteric has been often counted a fraud and an impostor. Janet asks the pertinent question, "How is it that, in all civilized countries, hystericals should agree to simulate the same thing ever since the Middle Ages up to the present day?" He answers his own question: "Anæsthesia is no ordinary absent-mindedness; it has more clearness and duration. *There is in it a pathological incapacity* to collect elementary sensations in a general perception."

It can be shown that the patient does actually sense the experiences, but is unable to connect sensations with the personality.

It is not the observer alone, however, who notices the contradictory attitude of the patient; commonly the patient is able to notice that impressions and experiences are contradictory and inconsistent, which fact may cause the patient to mislead himself with inaccuracies of statement. In fact, the patient becomes introspective and analytic of the condition, which in turn tends to the intensification of the symptoms.

Among the more or less permanent mental disturbances are:

1. Diminution of attentive power.
2. Disorders of memory.
3. Disturbances of the affective state.
4. Disturbances of volition—aboulia.

1. Attention.—As already pointed out, the weakened power of attentiveness interferes with the normal associations and therefore the attention is passively held by dominating ideas producing a condition of mental automatism.

The patient has the appearance of living in a dream state in which mental reproductions of past experiences are assimilated and reacted to afresh. Certain fixed ideas are commonly present but can only be determined by psychological analysis or while the individual is in a hypnoidal state.

2. Memory—Double Personality.—The disorders of memory in hysteria are peculiar in that certain events induce imagery in an automatic fashion, although the same events cannot be recalled when an effort to do so is made by the patient. Somnambulism is accompanied by a retrograde amnesia which covers not only the period of the somnambulism but also embraces the period corresponding to the event which has given rise to the delirium (Janet).

Continuous amnesias are characteristic in all cases of "double personalities." Patients pass into sleep-like states, upon awaking from which they find that they have forgotten all that they knew. Then follows a second period of sleep; when the patient wakes nothing is remembered of the period following the first sleep, nor of the new personality which developed subsequent to the period of sleep.

Usually in such cases following a period of sleep the patient awakes

experiencing a feeling of strangeness and is found to be in a mental state devoid of memories of the past. Little by little he is obliged to undergo fresh instruction in the matter of all things with which he was formerly acquainted. Such patients usually acquire knowledge rapidly —more rapidly than in the normal state—and soon become again familiar with persons and things in the environment, but still occupy an attitude as if objects were seen for the first time. It is in this state that the patient may develop the new or second personality which may persist for days, weeks or months. The patient may again be seized with a sleep similar to that which preceded the new personality and when awaking finds himself in the same state as before the first sleep, but with no remembrance of the new personality or of anything that happened in the interval. The two personalities may then alternate for years with a certain amount of regularity. In neither of the states is the other state remembered, nor is one personality known to the other. Numerous biographies of double personalities have been written. The best known in this country are those of "Ansell Bourne," by William James; "Miss Beauchamp," by Morton Prince, and that of "Thomas Hanna," by Boris Sidis.

3. Disturbances of the Affective States.—The abnormal emotional tone largely dominates the clinical picture in hysteria. The patient is controlled more by the feeling tone than by judgment or even conventionalities, is excitable, hypersensitive and excessive in all reactions; everything in which the patient is interested is referred to in superlatives. Sexual excitement appears often to be increased, but usually it is spurious; on the contrary, there may be absolute sexual indifference. The rapid change of emotional tone is a frequent characteristic. In a brief space of time this may pass from gayety to sadness, from joy to anger.

The accompanying mental depression gives rise to a multitude of subjective symptoms. If sufficient sympathy is not expressed for the patient, states of anger are aroused. The patient seems to derive satisfaction from a rehearsal of physical ills and craves attention irrespective of the convenience or comfort of others and commonly accuses those in attendance of wilful neglect and inattention, always demanding yet never satisfied.

4. Disturbances of Volition—Aboulia.—In spite of considerable activity and apparent interest in some directions, the hysteric is able to accomplish very little. Very susceptible to suggestions to carry out certain activities, yet interest is soon lost and an attitude of indifference supervenes. Deliberate effort is rarely made and if so continues but for brief periods on account of extreme physical and mental fatigue. Janet believes that the insomnia which is so constant is the result of aboulia—that is, the patient is unable to decide whether or not to sleep. Likewise such patients are unable to make up their minds to do anything—in short, "they cannot will."

Treatment.—The treatment of hysteria practically always involves the removal of the patient from the condition under which the symptoms developed. Removal of the patient from home is not essential provided that there can be maintained more or less isolation of the patient from the influence of suggestions likely to furnish the means of intensifying the symptoms and, equally important, of counteracting the efforts of the physician in charge. A fundamental necessity is the ability of the physician to stimulate an attitude of confidence in the patient, so that she will keep from her medical adviser nothing connected with the illness. The fact of releasing everything from the privacy of one's thoughts is in itself not infrequently a means of mitigating uncomfortable symptoms and of causing other symptoms to disappear.

It is upon this well-known fact that the machinery of psychoanalysis is largely supported and kept in motion.

The hysterical patient has a great number of subjective symptoms to which attention must be given. The physician who is able to determine just how much attention should be given to these symptoms will be the one who is most successful in treating the patient. Nausea, vomiting and headache are common symptoms complained of by the patient, backache and headache are frequently associated and are the cause of most of the patient's misery. An anæsthesia or reversal of the color fields is not complained of, because those symptoms do not annoy the patient.

The symptoms for which the patient seeks relief should be given their full value in the attitude of the examiner, while such symptoms as an hemianæsthesia or a paralysis should not be unduly weighted with a statement of their importance in the presence of the patient.

It should be explained to relatives, however, that they are the stigmata of the disease and that when the patient recovers from the attack the palsy or anæsthesia will disappear.

Headache is sometimes a troublesome symptom which, on account of the fact that it does not yield to medicinal treatment alone, may lead to the formation of the headache-powder habit. It is often intensified when the patient raises her head from the pillow and often seems associated with the pain in the back or ovarian (?) region or urinary bladder. Some patients insist that there must be serious internal trouble to cause the pain which immediately moves to the head. After sufficient examination has been made to permit of the elimination of organic disease, the physician should be willing to recognize that the symptoms complained of are of sufficient importance to receive direct attention, and yet at the same time it should be insisted upon that the patient will be relieved of her suffering.

It must always be remembered that hysterical symptoms may be present in company with organic disease, hence all examinations should be made with this possibility in mind.

The patient should be impressed not so much with the importance

of the physical examination; rather with the importance of the matter of the treatment and the process of getting well. All the details of the complaints should be heard attentively by the physician and an attitude of interest should be invariably maintained. Objections on the part of the patient to the lines of treatment should be met with firmness and kindness, insisting that it is necessary for a successful issue. A show of hostile antagonism to the patient usually acts unfavorably upon the symptoms and at the same time minimizes the physician's usefulness in that particular case.

As a rule, the patient's treatment should be begun with a view to securing a maximum amount of rest with a minimum amount of effort and liberal feeding, with especial attention to the eliminative functions which by reason of their default are responsible for many of the subjective symptoms.

In cases in which there are pronounced headache, vomiting, backache, vesical tenesmus or other symptoms that are aggravated by bodily activity, the patient should be kept in bed for a time at least. The indications in the individual case must be the guide in that respect. In the full rest treatment the patient is allowed to get out of bed only for bowel and bladder evacuations. The absence of exercise is provided for by massage and mild faradic stimulation of the muscle groups.

The diet should be liberal, non-stimulating and easily digested. Attention should be given to the digestive functions and the stools watched to see that the forced feeding is not pushed beyond the digestive powers. It is well to begin feeding with milk, milk and eggs, to which gradually is added a diet of vegetables, omitting the more bulky starchy tubers and fresh breads. As the digestive functions give evidence of their ability to assimilate a full mixed diet, the amount and variety are increased gradually.

The patient is gotten out of bed a few minutes daily, increasing the time gradually up to a few hours each day. At this juncture moderate exercise may be begun. Sitting out of doors should be begun, if possible, before the patient begins to walk, which likewise is permitted to be increased by degrees.

The mental phase of the hysterical condition is the one which needs special attention. In fact, in addition to the beneficial effects of enforced rest and feeding, the institution of a carefully carried out régime has its psychotherapeutic value which cannot be discounted. The importance of suggestion or "persuasion" has been emphasized in the beginning of the discussion of hysteria. The patient, when well in hand, is ready to profit by helpful suggestion and advice from the physician.

Special symptoms, such as localized pains, nausea, vomiting and headache, will require special methods of treatment. These are usually more readily influenced by local measures than by drug medication. Local applications of heat or cold, massage and faradism are beneficial on account of the element of suggestion which attends their application.

Medication in the form of digestive tonics, iron, phosphorus and arsenic is sometimes indicated by the general condition of the patient.

Neurasthenia (Fatigue Neurosis [2]).—While the term neurasthenia implies a condition of nervous weakness, exhaustion or prostration, usually thought of, especially by the laity, as involving chiefly the physical functions, in the strict sense of the term the symptoms implicate the mental sphere.

The condition is the outcome of an increased susceptibility to fatigue and nervous (emotional) irritability. The increased irritability depends upon the state of nervous exhaustion, which in turn increases the irritability, thus producing a nervous "vicious circle." The mental symptoms are shown chiefly in the form of diminished attentive power, difficulty in thinking and fatigue following attempts at continued mental effort. At the same time, there is an increased susceptibility to fatigue following physical exertion and an accompanying train of subjective symptoms.

Etiology.—The underlying cause of neurasthenia is an increased susceptibility to fatigue which may be either inherited or acquired. The patient shows an inability to continue mental or physical work for more than brief periods, so that he is soon exhausted and at the same time reacts excessively to mental and physical stimuli. Moebius regards the condition as due to a chronic state of intoxication. In the acquired cases this condition arises as the result of excessive mental effort with insufficient rest and relaxation. At one time neurasthenia was characterized on the continent of Europe as the "American disease" on account of the prevailing idea that the typical American life was made up of stress and strain entailed by great business responsibilities or daily life of uninterrupted social demands.

As a matter of fact, it is among the more energetic, talented and successful men that the disorder is most prevalent. Persons of the finer temperamental qualities and those who are particularly skilled and among the well-educated class are more apt to become affected.

Symptoms.—The most conspicuous signs of neurasthenia are fatigue and excessive nervous irritability. These symptoms are classed as sensory, motor, visceral or somatic and mental.

The sensory symptoms are manifestations of the state of hypersensitivity of the nervous mechanism, which results in an excessive response, which easily gives rise to a state of exhaustion. Subjectively the patient has numerous complaints, among which the most conspicuous is the persistent feeling of fatigue. He states that he never feels rested; the feeling of fatigue is usually most marked early in the morning and is invariably aggravated by mental or physical exertion. There may be hypersensitive spots or areas elicited by pressure, especially along the spine, but diminished sensibility or anæsthesia is not present.

The motor symptoms are pre-eminently those of weakness which is increased as the result of continued or repeated efforts. The patient

may state that he cannot walk without extreme fatigue. Tremors which become pronounced with muscular effort may involve entire extremities or groups of muscles or bundles of muscle fibres as fibrillary tremors.

The visceral and somatic disturbances especially involve the digestive and circulatory apparatus. Discomfort during the period of digestion, usually some time after taking food, is a common symptom. No physical signs of impaired digestion are apparent which cannot be attributed to inefficient innervation. The symptoms complained of are a sense of heaviness and oppression in the region of the stomach with a tendency to eructation. The bowels are usually constipated on account of the sluggishness of peristalsis due to diminished muscle tonus.

The circulatory apparatus likewise shows signs of functional disturbance of nervous origin. The superficial and deep reflexes are exaggerated, and there are tremors of the eyelids when partly closed and of the tongue when protruded and of the extended fingers.

The patient complains of cardiac palpitation and coldness of the extremities. The pulse is variable in its rhythm and tone, slight exertion or mental excitement may produce tachycardia. These are commonly vasomotor fluctuations shown by perspiration, pallor, blueness or flushing of the cutaneous surfaces.

The circulatory irregularities are closely associated with the disordered emotional tone as will be considered later.

Headache is often a persistent symptom which is usually described in definite terms, as a sense of weight, pressure, heaviness, especially in the region of the occiput, with a sensation of drawing the head back upon the shoulders. Dizziness, tinnitus aurium and visual disturbances are frequently complained of, especially after exertion.

Among the *mental symptoms,* fatigue stands out most prominently. At first the outward signs of mental exhaustion may be masked by the tendency on the part of the patient to persist in his work, which in turn serves to intensify the susceptibility to fatigue. Before long this shows itself unmistakably by diminished attentive power, distractibility, *apparent* loss of memory, together with a marked reduction in the capacity for mental effort.

The patient usually complains that he cannot concentrate his mind, that he cannot remember what he has read a few minutes before, that it makes him tired to think, that he has lost his former interest in matters which he knows ought to have his attention and that he dreads meeting situations which call for decisions; consequently he is obliged to neglect important work. One patient stated that he would sit at his desk and look at his unanswered mail, but could not arouse enough energy to begin to dictate a letter.

Emotionally, there is a state of irritability commingled with peevishness, impetuosity and fault-finding tendencies. He may be angered by trifles which only serve to intensify his mental incapacity. He may try to make amends for his loss of self-control, but is unable to keep

his promise in that respect. He has periods of depression of spirits with outbursts of tears. On account of the emotional disturbance, he is apt to exaggerate the importance of his symptoms, and say that he is losing his mind, that his memory is going, that he is developing "paresis" or "softening of the brain." He is over-anxious about the state of his health, frequently going from one physician to another on account of his inability to satisfy himself with the truth. He is in a state of constant fear of death; the fear may appear in paroxysms during which the subjective symptoms become intensified; the tachycardia, præcordial and epigastric distress are interpreted by him as certain signs of serious heart or lung disease. At such times emotional crises are likely to arise, when the patient paces the floor, wrings his hands or clasps his head. These scenes are more often brought about by fear rather than by actual suffering and must be carefully differentiated. He may threaten self-destruction or even make attempts at suicide, for which he usually is profuse in his expression of feelings of remorse.

Diagnosis.—The differential diagnosis is important, not so much on account of the possibility of confounding neurasthenia with other disorders, but rather on account of the ease with which troubles, such as the depressed types of manic-depressive psychoses, involutional melancholia, dementia præcox, general paralysis and neurasthenic states dependent upon or associated with organic disease, may be mistaken for neurasthenia.

The mental depressions of other psychoses are apt to be more uniform than the neurasthenic depression, and in fact tend to grow worse before there are signs of amelioration. The depression of neurasthenia is subject to fluctuations induced by accidental environmental happenings. The neurasthenic is more easily diverted from his depression; especially is this so as soon as he is removed from the surroundings and conditions under which the depression arose. Relieve the patient of his cares, out of sight and hearing of his business affairs he often becomes brighter and less worrisome and indeed may show signs of mental relief.

In the true depressions there is the element of sadness and anxiety which persists in spite of change of environment. the delusional content is based upon a feeling of unworthiness not influenced by environmental change and is out of proportion to facts of the patient's experience. There is either psychomotor retardation or agitation with the depression which likewise is more or less uniform and consistent with the emotional tone. Involutional melancholia presents the picture of dejection with hypochondriacal delusions and anxious restlessness. Dementia præcox presents in its early phases the general outward appearance of neurasthenia, but the symptoms complained of by the patient are usually lacking in definiteness; the emotional indifference and the lack of coherence between the emotional state and the delusions are rather characteristic.

General paralysis may resemble neurasthenia very closely, especially in the absence of the physical signs necessary for the diagnosis of paresis. Needless to say the laboratory findings are of fundamental importance, although these alone should not be permitted to support the entire weight of the diagnosis. It is in the early phase of paresis that the diagnosis is made difficult. Usually one or more suggestions of organic nervous disease will be present which should serve to guard the diagnosis, especially a sluggishness in the pupillary reaction with slight inequality together with altered deep reflexes, should be sufficient to make a careful serological study imperative.

Mentally the neurasthenic presents an amount of insight not possessed by the paretic, even though he is depressed and hypochondriacal; the paretic may complain of suffering from weakness and prostration, yet he fails to realize the seriousness of his condition or else is grandiose in his depression, which leads to the expression of impossible ideas.

Treatment.—The treatment of neurasthenia involves a course of systematic attention to details for the success of which it is necessary for the physician to inspire confidence into his patient and to insure the fullest possible coöperation. It demands the removal of the patient, as far as possible, from the source of the exciting factors that were active in the production of his disorder.

It requires a maximum amount of mental and physical rest, a suitable amount and kind of food and the elimination of waste materials in proportion to the amount of food digested. Assuming that the neurasthenic state is the outcome of a lack of balance between the amount of energy expended and the ability to overcome the effects of fatigue, rest is the first factor which must be given consideration.

It is usual to select for each patient a routine of either partial or complete rest treatment, depending upon the degree of exhaustion manifested, or the ease with which a state of fatigue is brought about after mental or physical effort. In the milder cases it may seem advisable for many reasons to modify the so-called "rest treatment." The number of hours' work should be reduced to a minimum and the number of hours of rest increased to the maximum as circumstances will permit.

If possible, the patient should rest in bed at least ten hours without interruption each day, with an additional two hours some time during the day, preferably in the early afternoon. A short trip to new surroundings may be beneficial provided that no attempt at sight-seeing is made that is likely to produce fatigue. The diet of the patient for whom the partial rest treatment has been selected should be as liberal as may be consistent with the condition of the digestive functions.

In the outline prescribed by Mitchell a number of years ago, the addition of milk to the regular diet was insisted upon. On account of the aversion of some patients to drinking milk, it may be necessary to start with two or three ounces at a time with the meals, between meals

and at bedtime. A diet, consisting of milk, eggs and the less starchy vegetables and fruit, together with the lighter meats, leafy vegetables, spinach, Swiss chard, stewed celery, cresses and lettuce, is of value on account of its bulk, which helps to overcome the tendency to constipation, in addition to its dietetic value.

The amount of carbohydrate should be limited especially early in the treatment in order to avoid fermentation of starchy and high sugar content foods. Rich pastry, cake and confections should be interdicted as should all stimulants, including tea, coffee, tobacco and alcoholic beverages. Elimination should be secured by attention to the skin and bowels. A cool bath, followed by slight friction, in the morning is of service as a stimulant to the skin. In patients who have been unaccustomed to a cold morning bath a gradual hydrotherapeutic education of the vasomotor apparatus may be accomplished by a daily reduction by a few degrees in the temperature of the water. The regulated shower-bath is best for this procedure. In the evening a warm bath is beneficial on account of its eliminant and sedative effect.

Massage is useful as a substitute for exercise until the time arrives for active exercise. As the patient gains strength the amount of exercise permitted should be increased. In states of extreme exhaustion there is a demand for absolute rest in bed, allowing the patient to make no physical effort without the assistance of the nurse.

In some of the cases of profound exhaustion the patient complains of a sense of extreme prostration and helplessness. In patients who manifest great *mental exhaustion* the problem of securing rest becomes more difficult. It may be a comparatively simple matter to apply the methods of absolute physical rest with isolation from the family in the home, or the removal of the patient from home and still the matter of securing mental rest be very difficult. The patient may suffer from marked mental fatigue upon the slightest effort at concentration, and yet when attempting to relax mentally the patient complains of an endless flow of unwelcome ideas which in themselves add to the feeling of mental fatigue. It is this class of patients which presents the admixture of the neurasthenic state with that of the psychasthenic type, a symptom group not infrequently encountered.

These patients require isolation from family and friends, preferably away from home. No one but the physician and nurse in attendance should visit the patient. It is almost unnecessary to state that the nurse should qualify as the possessor of much patience, tact, gentleness with firmness, and as one who is able to learn the patient's mental characteristics, who is attentive to details of the treatment and, above all, one who is not inclined to discuss her own affairs or those of others with the patient. The art of companionship and skill in nursing are qualities much to be desired and difficult to combine.

In states of marked exhaustion very careful attention must be given to the matters of food and elimination. The amount of food

should be limited to the patient's ability to digest. It may be necessary to begin with a diet of milk alone, five or six ounces, taken slowly, given at two- or three-hour intervals in the day. If whole milk cannot be taken by the patient, one of the modifications of the milk diet may have to be tried. The addition of carbonated alkaline waters to the milk will increase the palatability for some patients. As soon as possible, eggs should be added to the milk diet. These may be given either beaten and added to milk or taken raw alone.

No less care than that exercised in connection with the feeding of the patient is imperative in the attention to the matter of elimination. Dercum [3] regards many of the subjective symptoms, such as the vague aches and pains of the neurasthenic, as the outcome of disordered metabolism with faulty elimination and the retention of waste materials.

With this the present writer is fully in accord, especially in connection with those cases of acquired neurasthenia with pronounced mental symptoms—fatigue and depression. True it is that recovery is not to be looked for immediately after the correction of the eliminative function for the reason that not infrequently this factor has been operative for a long time prior to the appearance of the nervous symptoms.

On the other hand, combined with rest for the too easily exhausted nervous system and the regulation of the food supply, the need for attention to the functions of elimination cannot be given too much emphasis. As already indicated, the evening warm bath and the morning cool sponge are valuable adjuvants in favoring elimination because of the beneficial influence upon the vasomotor apparatus. The prevention of decomposition of food in the gastro-intestinal tract can usually be managed by the selection of the proper amount and kind of diet, but on account of the sluggishness of the gastro-intestinal musculature constipation will occur if not combated by preventive measures. The bowels should be open daily by enema, if not otherwise, or by the administration of some simple vegetable laxative. Under favorable conditions it will be noted that the patient shows signs of gradual gain in strength, the state of nutrition improves, there is a gain in weight and the color of the skin is improved, and the tone of the tissues becomes increased.

It was stated in the first paragraph that the success of the treatment depends in a large measure upon the degree of confidence which the patient gains from the physician. In this connection it must be stated that the patient must be more or less constantly impressed with the idea that he is occupied with a "getting-well" process and that his coöperation is essential. From the standpoint of psychotherapeutics, it is essential that the physician shall know his patient and that the patient shall be conscious of this fact.

In the psychasthenic phases of the disorder, this is of greatest importance; the patient should have the opportunity to express freely

to the physician such personal matters as will relieve a condition of mental stress, anxiety or worry and thus favor the progress towards recovery. Family misunderstandings, disappointments and indiscretions, either sexual or otherwise, may act as operative factors in the psychoneuroses and depression, giving rise to a feeling of self-accusation or personal unworthiness.

The question of psychoanalysis as a means of treatment of the neurasthenic states naturally presents itself at this juncture in the light of the great amount of attention which has been given to the subject both in lay journals and in neurologic contributions. Numerous have become the exponents of the theories of Freud, Jung and their followers. The present writer has as yet not been able to acquire the point of view that all of the failures at adjustment shown by the neurasthenic and psychopathic states are regarded as the expression of an autoerotism and therefore as having an etiology which rests upon a sexual foundation and the feeling of shame which accompanies the habit of masturbation.

As far as the types of neurasthenia which take on a clearly sexual character are concerned, the necessity of long, drawn-out psychoanalysis is usually absent.

The experience of the writer is in accord with that of Dercum and Lloyd that the instances in which sexual matters form the basis of worries, fears and depressions are not in the majority; that the results to be obtained can be reached without resorting to the operation of "mental catharsis," which has the disadvantages of being tedious, painful to the patient and in the end indefinite as to the accuracy of the results obtained, for the reason that it is difficult to clearly separate that which is primarily the product of the patient's mind from those psychoanalytic results which are products of the examiner's mind.

The matter of psychoanalysis has as yet not reached its proper level. Until that condition has been reached it would be well to accept those portions of it that can be demonstrated beyond hypothetical bounds to be of real value and avoid as far as possible going out of the way to inject into the fatigued patient's mind a score of ideas which even though "submerged" in the unconscious, possibly may do less harm than if brought to the patient's realization.

Psychasthenia (Compulsion Neuroses).—As indicated in the terms used to designate this class of neuroses, the symptom-complex has for its foundation an inability to control volitional process, with the result that the patient is obliged to think or act along certain lines against his will.

When the compulsion arises it gives to the patient a feeling of mental discomfort which persists until the thought or act is carried out. Following this yielding to impulse there is a period of mental relief which lasts until the compulsive idea arises again. As time goes on the patient finds himself more or less constantly in a condition of mental struggle.

He knows that to yield is an admission of his mental weakness, yet not to respond to the compulsion causes him mental distress.

Symptoms.—The principal symptom in the compulsion neuroses is *obsession*, which involves the content of thought, attention and volitional processes.

The patient's mind is obsessed by thoughts which often involve subjects in which he normally has no interest, or they may concern trivial, commonplace matters. The obsession may involve a sensory or emotional trend or various kinds of obsessive actions.

The largest group of obsessions are those that are connected with emotional states of fear, termed **phobias.** These are usually directed towards some definite object or class of objects or conditions. The most common is the fear of dirt or contamination (*misophobia*). The next in importance are the obsessions of doubt (*folie du doute*), characterized by the mental state in which the subject is unable to decide between two alternatives of action, as often occurs in the normal person, after having completed an act, such as turning the key in the door lock, he is unable to decide whether or not the act was done, and hence he is seized with the compulsion to go and investigate in order to satisfy himself.

Other doubt obsessions may involve abstruse subjects in science, religion and philosophy, which force themselves upon the patient's mind with unanswerable questions and propositions from which he is unable to get relief of thought. He questions and reasons and discusses his own thoughts until he is mentally exhausted.

Other phobias which are somewhat less common are the fear of large spaces (agoraphobia), and the fear of being in a small space or enclosure (claustrophobia).

Among the motor obsessions or obsessions of action are the so-called manias, such as pyromania, in which the patient is compelled to set fire to something; the kleptomania with a compulsion to steal, and the dipsomania with a compulsion to drink.

Obsessions may arise as emotions, or as ideas, which hold the attention and occupy the train of thought to the exclusion of other ideas. The patient is fully aware of the absurdity of the position in which he is placed, yet he is powerless to exclude certain ideas from the field of consciousness. On this account the ideas are termed "imperative ideas," which are to be distinguished from delusive ideas.

Etiology.—The fundamental cause is the underlying psychopathy which manifests itself in many ways and which may be apparent from childhood. The early history commonly reveals the fact that as a child the patient was "unusual," irritable, hard to manage at home, yet without stamina and not inclined to assert himself among playfellows. He is very susceptible to suggestion and influenced by example. A four-year-old boy brought by a neurotic mother for medical examination, remarked, without an external sign of fear, "Oh! I am so nervous."

Needless to say, it was an expression he had been brought up on, having heard his mother make use of it many times.

As the child grows older he develops an extreme degree of conscientiousness often looked upon as a virtue by his elders. He is extremely sensitive, emotional and gives vent to outbursts of anger or ecstasies of joy; there is an habitual tendency to self-examination and excessive scrupulousness. In early adult life many of these peculiarities may disappear, from the surface at least, only to reappear, intensified in one or another direction, as the result of a condition of mental fatigue brought on by excessive work, strain or some physical illness.

The types of obsessions and phobias are almost as numerous as there are persons affected. There are, nevertheless, two main groups which may be identified as: (1) **inhibiting obsessions,** (2) **impulsive obsessions,** according to the effect which the abnormal emotion, action or idea has upon the individual. Each of these groups may assume various forms dependent upon the content of the associated ideas. Even such a grouping as the above is of value merely as a convenience, and it must be remembered that even these may overlap. For example, an inhibiting obsession may be inhibitory to one line of thought or action, while it may give rise to an impulsive idea or act. For example, a young woman is beset with the idea that her hands are not clean in spite of numerous washings. The "feeling" that there is still a remnant of dirt impels her to wash repeatedly. The act of washing must be repeated so many times that she spends the entire day in the preparation of her toilet, so that she, finally, obliged to give it up, goes to bed exhausted. Here clearly the one impulsive act becomes an inhibiting obsession to the acts which are really desired. The patient repeatedly says, "I do not want to look for dirt on my hands, but I must look." Any attempt to interfere with the impulsive act only makes the desire to carry it out all the stronger. For example, an attempt to force such a patient to retire in the dark, so that she cannot see to examine objects, produces a state of mental panic and with a determination, which is sometimes violent, to get into the light in order to relieve the distress of mind.

The most common of the inhibiting obsessions are the obsessions of doubt. As already mentioned, these are akin to the states which sometimes arise in the normal mind, when doubts arise concerning the locking of a door, the turning off of the gas, or the sealing of a letter after it has been dropped in the post-box. In the abnormal state the doubt cannot be shaken off, but persists in the patient's mind in spite of himself. A man who was dominated by such obsessions saw, when he was passing a house where a cement paving was being laid, a broken piece of stone which to him seemed to have a peculiar shape. He began to wonder whether it was lying with its largest face or one of its angles up. The idea was so persistent that after he had retired he was obliged to get up and dress in order to look for the stone. When he

reached the spot a few doors from his own house he found that portion of the work had since been finished, and the knowledge of the impossibility of his ever answering the question being banished, he was able to retire in peace for that occasion.

Closely allied to this form of obsession is the *délire du toucher,* in which the patient shrinks from touching anything with the hands or any part of the body on account of the fear of contaminating other persons or things or the fear of becoming contaminated or infected. Thus, on occasions, a patient objects to shaking hands because she is not clean and consequently spends the greater part of the morning washing.

The impulsive obsessions are chiefly those of pyromania, kleptomania and dipsomania. The obsessive impulse to set fire to houses, barns and haystacks must be clearly separated from the same tendency seen in imbeciles and children. In the obsessed condition the subjects may appear to derive a degree of satisfaction after the act has been done, although they later express profound regret, or the act may naively be denied, or, as is more apt to be the case, the patient may state that he has no recollection of having committed the act. A patient examined by the writer had been first suspected and then accused of having set fire to a house and a barn; he remembered making the necessary preparations for the act, but could not recall having actually set fire to the building, although he took an active part in trying to extinguish the flames.

Another interesting type of obsession is the intellectual type in which ideas dominate the attentive consciousness and present themselves in the form of a "fixed idea" which may assume the form of a question, as "What is the mystery of life?" "Is there a Diety?" and other similar abstruse problems. Sometimes the idea becomes a doubt, as in the inhibiting obsessions.

More rarely the obsession takes on the form of scruples. The following extract from a letter, written by a patient who developed an over-scrupulous trend in regard to the possibility of his being responsible for weeds growing in his neighbor's garden, will serve to illustrate the condition:

"In regard to the paper bag with the ashes in, in the little outbuilding, and also the sweepings in the newspapers, I want them burned in a boiler-fire, where there is a large bed of coals, so that no seed will get away. Also the ashes in the stove might be burned again in some larger fire, because there might be some seed gathered up among the coals from the wood-shed and scattered in some way or other. There are a lot of those large weeds growing along the outside of the field, and also among the corn, that might be burned. Think of what I may have to account for, for not having attended to those fields. You cannot have an idea of what a person suffers who is conscience-stricken and scrupulous. You might take Father B. down to see the fields; but as he visits sick people he may carry germs and disseminate them on the corn fodder and in that way convey tuberculosis through cows or cattle to people, and thus do a lot more harm, and the end no one could tell. If Father B. says that it is all right to let the corn go and waste on the field, and that there would be no sin or harm if people went in and took the corn without asking for it, even if you and I were willing to let it go to waste. No matter what is done, I do not want to be responsible."

War Neuroses.—In the present group of neuroses are to be included all of the manifestations of functional nervous disturbances which occur during the environmental changes in persons who are brought from civil life into contact with army life and experiences. Investigations have shown that the conditions have arisen not only among men who have been exposed, on the firing line and elsewhere, to the atmospheric disturbances produced by high explosives, machine-gun firing and gassing, but also when there has been no firing at all. This, of course, appears to indicate that the term "shell shock," used to describe those cases occurring in the early war experiences, is a misnomer. Furthermore, Bailey [4] states that all of the symptoms designated as war symptoms have been observed in the home-training camps in cantonments.

Early in the war the term "shell shock" became so universally applied that it was used to designate all nervous symptoms appearing in soldiers who were exposed to shell fire, that could not be explained on the ground of actual physical injury to the nervous tissues. In fact, the meaning of the term became so well known among the soldiers that many of them developed a morbid fear of falling victims to the affection. In a certain number of instances death occurred which was apparently caused by the explosion of shells or mines without any visible signs of external injury.

Also severe neurological symptoms were observed following general bodily concussion by explosions. Mott [5] concluded that the concussion following the atmospheric compression and consequent rapid decompression and also the effects of "gassing" and other mechanical factors may result in either temporary or permanent nervous lesions. For these two groups of cases only can the term "shell shock" be correctly employed.

According to Salmon,[6] the largest group of cases is found to be made up of men who had not been exposed to battle conditions, and even among non-expeditionary forces. It also is a pertinent fact that the clinical appearance of the war neuroses resembles that of the neuroses met in civil life among cases in which there is no mechanical or physical shock present as a factor.

The greatest proportion of "shock" cases occur among officers, which fact agrees with the place occupied by neuroses of civil life among the better social classes. Soldiers who have been wounded and exposed to similar conditions do not develop neuroses as do their comrades who were not wounded.

Even among those who received actual wounds of the nervous system, the symptoms found in the "shock" cases do not develop.

An explanation of the occurrence of the symptoms as met in the "shock cases," based upon psychological grounds, seems, at the present time, the most satisfactory that has yet been offered.

It has been observed that in the vast majority of cases the soldier

loses one of the functions which is essential to war or which prevents him from making adjustment to the conditions imposed by war.

For the development of the condition there is required first of all a person who is constitutionally neuropathic, added to which the environmental change and the accompanying strain constitute the exciting factors. The mental attitude of the man towards his affairs at home has also an exciting influence. Cases are reported in which "shell shock" developed in the soldier after the receipt of unfavorable news from home.

The disturbances found among the patients classed as "shock" cases fall into two groups:

1. Disturbances of psychic functions: Among these were delirium and hallucinatory confusion, amnesia and anxiety neuroses.

2. Disturbances shown by disordered physical function: (*a*) Cardiovascular disturbances: Functional heart disorder, lowered blood-pressure, diarrhœa, polyuria, sweating, vomiting. (*b*) Disturbances of voluntary musculature: Paralyses, contractures, tremors, disturbances of gait, tics, convulsions and disorders of speech. (*c*) Sensory disorders: Blindness, deafness, hyperæsthesias and anæsthesias.

Among the neuroses, Read[7] states that in his experience neurasthenia is "decidedly" rare, in which view other observers concur. Read regards the condition which has been termed neurasthenia in soldiers as really "anxiety-hysteria."

Most of Read's observations were upon such hysterical manifestations as paraplegias, disturbances of gait and the involuntary muscular movements and speech disorders, including mutism, aphonia and stammering. Hysterical deafness is associated frequently with mutism and reduction of vision, combined with blepharospasm. Monoplegias and partial hemiplegias were found complicating surgical conditions among the wounded.

Anxiety hysteria was found more commonly among officers, to whom is entrusted greater responsibility than is given the men in the ranks. The conspicuous symptoms are a feeling of anxiety and dread without definable cause, insomnia, bad dreams, headache and great exhaustion following slight physical or mental exertion. In some instances special phobias form a part of the picture.

Read states that **amnesic fugues** are frequently seen on the front line, and he believes that some sufferers probably have been punished for desertion. The patient who wanders away from his post is totally amnesic for the period of the fugue when he comes to himself. There may be apparent no other symptom than the memory gap.

Amnesia covering a definite period or extending so far backward as to cover the patient's entire life, may give rise to the formation of secondary personalities as are met in hysteria in civil life.

The question of the differentiation between voluntary desertion and unconscious desertion naturally comes up for solution in these cases.

The answer is based upon the establishment of other indications of neuropathy in the patient.

The "war neurosis," then, may be regarded as a reaction which, by reason of some acquired disease or constitutional defect, predisposes the military man to some functional or reflex nervous disorder. Infections, acute and chronic, such as syphilis and the infectious fevers, may be contributing factors; intoxications, as in alcoholism and drug addiction, are not only predisposing factors in themselves, but in many instances are to be regarded as evidence of inherent neuropathy.

Mills considers that some of the symptoms which have been observed among the "shock" cases cannot be entirely explained upon a hysterical basis and must, therefore, be due to some commotional disturbance in the central nervous system which is curable—the disturbance being of a physiochemical nature.

Treatment.—The question of treatment resolves itself largely into the matter of psychotherapy as in the neuroses of civil life, except due consideration is given to the military situation.

Many of the observers in military medicine in the neuropsychiatric sections are inclining strongly to the dictum of Babinski in regard to the cause and means of cure of the symptoms.

On this basis Bailey urges against prolonging hospital treatment. In the first place the patient should be impressed with the fact that he has come to the hospital to be *cured,* and that he will be cured, and cured quickly. This is important for the reason that the longer the neurosis exists the more resistant it is to treatment. The patient's surroundings in the hospital, in the first place, should not be made too attractive. Even while under treatment the patient is kept under strict military discipline and is impressed with the idea that to fail to get well is in itself akin to misdemeanor.

The French have made use of the application of strong galvanic currents to the extent of producing painful reactions with good results in cases of hysterical deafness, mutism and partial palsies. Usually one treatment, it is said, is sufficient.

The after-treatment is largely centred about occupational therapy which has not only its value on account of the mental effect upon the patient, but because of its advantage as a re-educational measure for the restoration of function of parts that have been paralyzed or contractured.

The treatment of neurasthenics and psychasthenics is a separate problem and requires the same care as the psychoneuroses of civil life.

The effect of suggestion is utilized whenever and wherever possible. It is said that in some of the French hospitals, several days are allowed to lapse before treatment is begun in order to give an opportunity for nurses and recovered patients to make known the certainty of cure. In one hospital treatment room there is conveniently placed a collection of discarded canes, crutches and braces left by cured

patients and utilized, but only for the purpose of serving as an object lesson to the new patient.

Needless to say, it is important that diagnoses of functional trouble be established promptly that prolonged or repeated examinations may be avoided because of the baneful effect of the added suggestion.

Mental Disorders of the Epilepsies

The epileptic convulsive seizure with all its typical manifestations represents an extreme example of lack of adjustment to environment through loss of coördinate activity of the nervous mechanism. During the fit the patient's life may be in danger on account of the loss of consciousness and failure of his defensive reactions. He may fall down an elevator-shaft or throw himself against a stove or down a stairway; through excessive muscular contraction and interference with the respiratory mechanism death may result from asphyxia or exhaustion of a poorly nourished myocardium.

Etiology.—The subject of true epilepsy ("idiopathic" or "genuine epilepsy") in the vast majority of instances is an individual whose progenitors or collaterals have been sufferers from some form of neuropathy or psychopathy. Epilepsy and feeblemindedness are frequently found associated in the same familial stock, as has been shown by the study of pedigrees by Mott, Davenport, Weeks and others.

Exciting Causes.—Epileptiform seizures may be produced by almost any gross pathologic brain condition such as developmental defect, new growths, meningitis, abscess, softening, general paralysis and cerebral arteriosclerosis; also by toxic states such as alcoholism, uremia and diabetes, all of which constitute the symptomatic epilepsies.

A description of the characteristics of the epileptic seizure cannot be adequately considered in this discussion. Space will be given only to the phase of the subject of special interest from a psychiatric viewpoint; only the epileptic condition in relation to its mental aspect and the reactions of the patient which can be directly attributed to the epileptic seizures or their equivalents will be considered.

The underlying causes of long-continued and repeated seizures extending over a number of years tend, in the ultimate, to the production of a condition of mental enfeeblement. This is especially true of the epilepsies which begin in early life. Children who have repeated seizures in the first year of life which continue thereafter are often subjects of arrested development, which may reveal itself later as imbecility or idiocy. In most cases the operating factors which have interfered with cerebral development are the same or are dependent upon the causes of the epilepsy.

The epileptic seizures may be said to comprise three groups of phenomena: (1) the pre-paroxysmal, (2) those of the attack, (3) the interparoxysmal and (4) the post-paroxysmal.

The *preparoxysmal* phenomena may consist of states of depression

or stupor, states of excitement and confusional states. In some instances there may be prodromes extending over a day or two by which the approach of an attack or a series of attacks may be foretold—the so-called "psychic aura."

In the depressed states there is often a condition of languor, mental stupor, loss of interest and a tendency to somnolence.

In states of excitement there may be mild exhilaration, excessive irritability and in some cases particular emotional trends are manifested. Thus a patient before each attack begins with a depression during which he has associated with it a feeling of having neglected his spiritual condition, on which account he feels the necessity of reading the Bible continuously and fasting. Commonly states of mental excitement arise which may lead to a condition of frenzy in which the patient may prove dangerous on account of his tendency to attack persons without warning or apparent provocation. There seems to be a lack of directed effort, the violence giving the appearance of blind frenzy —the so-called "epileptic furore." In other cases the reaction seems to be the direct effect of a state of terror produced by hallucinations.

In the periods of transitory confusion the patient shows marked clouding of consciousness which may or may not be accompanied by sense falsification either as hallucinations or illusions. There may be complete disorientation, interruption of the normal association process and all that depends upon it. These symptoms usually disappear after the seizures.

During the epileptic seizures there is always a disturbance of consciousness. Practically every patient who suffers an attack of "genuine epilepsy" has no recollection of the attack itself, although he may be able to tell that he has had an attack by the subjective after-symptoms, such as drowsiness, headache, muscular soreness and a sore tongue. In attacks of *petit mal,* which are so often accompanied or followed by mental aberration, the patient knows nothing of the attack.

In the typical convulsive attack there is always a state of total loss of consciousness amounting to coma which is commonly followed by a state of stupor varying in duration from a few minutes to several hours. Active hallucinations may mark the attack, these often being of a terrifying character. An important group of seizures is that in which the attack itself is not accompanied by any convulsive manifestations, but instead a "psychic equivalent" which constitutes the so-called "psychic epilepsy." In these there exists a dream-like state in which complicated acts are automatically performed by the patient. As in the cases reported by the writer,[8] the act of undressing is very often carried out during the attack; one arteriosclerotic patient, a janitor of a country meeting-house, built a furnace fire in the church basement on a summer day during an attack. Another patient who suffered an attack while shovelling snow from the sidewalk came to himself to find that he had been shovelling for nearly half a block; a

third patient frequently undressed her baby during her attacks. Sir William Gowers cites the remarkable instance of the drayman who drove his team through the most crowded thoroughfares of London without an accident during an attack. Serious accidents and crimes are reported as having been committed during such attacks of epileptic automatism. Such cases are of medico-legal importance and require careful investigation to determine the real character of the seizure.

The *interparoxysmal* mental state is a condition which of necessity varies somewhat in each patient. Usually he is regarded as having an irritable disposition and subject to outbursts of anger. He may be suspicious, sullen, intensely introspective, hypochondriacal and cannot be relied upon as to the accuracy of his statements. The attacks of anger are characteristically present in about three-fourths of the epileptics. These patients are hard to get along with as a rule on account of their excessive irritability. They get into altercations frequently, especially in hospitals where the epileptic is obliged to come in contact with other mental patients who do not understand him.

The writer has observed two patients in whom there were epileptiform seizures in which the attacks apparently disappeared with the development of a manic-depressive syndrome.

The one patient at first suffered attacks of nocturnal epilepsy which were not observed, but were suspected by the frequent complaint of "bad dreams," followed by marked muscular soreness the day following the disturbed night. With the cessation of the fits the patient passed through a typical attack of mania from which he recovered after several months with clear insight. Another patient, also observed by Bond, suffered epileptiform attacks for twelve years; the attacks ceased with the appearance of cyclic attacks of depression and exaltation which have continued for a number of years.

Treatment.—The care of the patient during a convulsive attack consists in protecting him from injury during the period of unconsciousness, excitement or ambulatory automatism. All constricting bands about the neck and waist should be removed and the patient watched to avoid the danger of asphyxiation by his rolling face downwards in bed and to prevent aspiration of mucus or vomitus into the lungs and to prevent accident to life or limb by excessive muscular contractions and bodily jactitations. Restraint in the sense of trying to stop movements should not be attempted, but only means should be used to direct the movements. When the patient returns to consciousness he should be encouraged to rest for some time.

There has been an attempt to show that the epileptic seizures are often psychogenic in origin. This, of course, does not include the epilepsies resulting from organic disease or arising upon a clearly defined toxic condition. In genuine or idiopathic forms of epilepsy, this point of view regards the "fit" as a means by which the patient is enabled to avoid making an otherwise necessary adaptation.

These adjustments required are "at the deep instinctive level,"[9] and, according to this hypothesis, the disorder is a manifestation of deep-seated biological defects in the individual. Many patients show a progressive mental deterioration which in some cases is profound.

During the interval between attacks the treatment of the epilepsies not due to localizable or demonstrable cerebral changes, the methods to be adopted will, of course, vary with the individual case.

It is well known that functional disturbances of the alimentary canal and of the eliminative organs are common excitant factors in the production of convulsive seizures. After the elimination as far as possible of organic disease of the brain and its membranes, the treatment is essentially symptomatic. Careful regulation of diet is absolutely necessary. Food digestible by the epileptic is the food for the patient. Some authorities advocate omission of certain articles from the dietary. A salt-free diet has been suggested with the substitution of the bromide salts. These may be put in the patient's salt shaker for use at meals. A reduction in the protein content of the daily menu has also been recommended. The experience of those who see much of epilepsy teaches that these patients are apt to overeat, and are particularly fond of eating meats, especially beef.

Furthermore, they not only are likely to suffer from the effects of decomposition of undigested food, but they are also usually habitually constipated, which requires systematic attention. Surgical intervention in the form of abdominal operation for the resection of redundant portions of the intestine has been tried but apparently without any permanent benefit; doubtless due to the fact that the seat of the trouble is "higher up" than the abdominal cavity.

Rational hygienic methods, occupation, encouragement and the removal of all social obstacles are the necessary elements of treatment. In epileptic colonies where these methods can be carried out the recovery rate is said to be about 5 per cent.

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CHAPTER VIII

PARANOIA AND PARANOID STATES

REACTION TYPES CHARACTERIZED BY AN EXAGGERATED DEFENSIVE ATTITUDE, BASED UPON AN ABNORMAL EMOTIONAL CONTENT AND DELUSIONS OF PERSECUTION, WITHOUT MARKED INTELLECTUAL IMPAIRMENT, THUS PERMITTING OF PARTIAL ADJUSTMENTS.

PARANOIA is essentially a mental disorder of early adult life; its fundamental symptom is delusion. The condition is characterized by its gradual development in a progressive manner, and by the evolution of a system of fixed ideas, without evidence of marked mental impairment, and without apparent involvement of the process of coherent thought.

The term paranoia (*παρὰ*, close to, near, beyond; *νοεω*, to understand) was adapted from the writings of Plato by Mendel, who applied it to the form of mental disorder to which Kahlbaum had formerly given the name "Verrücktheit," a term that had come to convey a number of meanings, leading to more or less confusion in nomenclature. Paranoia also largely replaced the "délire systématisé" of the French and the "monomania" of the older English writers.

The question of what constitutes paranoia has furnished a debating ground for a number of years, and there is still some difference in meaning conveyed in the application of the name paranoia by various writers, but most authorities agree that it is a useful term, provided it be applied so as to mean one type of disorder only, namely, one which is a constitutional anomaly rather than a mental disease.

It will be assumed that the term paranoia, within the meaning of this description, applies to the chronic, systematized, progressive delusional form of mental disorder, which develops in individuals who are the possessors of an unstable nervous system, more commonly inherited than acquired, in persons, therefore, who are abnormal by nature, though not in any sense originally weak-minded. Paranoia has been spoken of as a disorder which is essentially intellectual in type.

In fact, many paranoiacs are in some respects mentally brilliant and may retain for years, in spite of the mental aberration, a remarkable degree of lucidity in regard to matters which do not enter into the composition of the system of erroneous judgment, which characterizes their delusions. These ideas, which may be either of a grandiose or persecutory type, remain with the individual until by advancing years he becomes mentally enfeebled, or dies as the result of some intercurrent affection.

Paranoia contributes not more than 1 per cent. of the residents

in hospitals for mental diseases; it is now regarded as less common than when the use of the term was not so restricted as it is at the present time. Mental states, resembling paranoia yet distinctly different conditions, formerly included under the term paranoia are now known as "paranoid" states.

Although true paranoia may have its beginning in the earlier years, it is a mental disorder, which appears in its complete form after the mental evolutive period is completed and is considered as a product of a defective mental organization. Most writers insist upon the fact that the foundation of the disorder is laid upon a psychopathic predisposition made up of constitutional defect by reason of bad heredity. The subject is the possessor of a peculiar habit of thought which results in the individual reaching conclusions by the shortest route of reasoning, conforming to that which in normal minds is known as prejudice. To this is added an egotistic and suspicious personality, together with an active imagination and emotional reactivity. [2]

The peculiar emotional trend which the individual habitually carries in his thought mechanisms prevents him from arriving at sound judgments, by reason of the fact that he is not permitted to consider certain elements which may be essential to a reasonable conclusion. The subject of paranoia commonly is a person of whom it is said by those who know him, that he was always "queer" or considered a "crank," that he looked upon the world from an unusual standpoint because he always possessed a peculiar mental "twist."

In many instances a study of the development of the condition means the study of the life of the individual from the start. Hereditary degeneracy is a conspicuous factor in these individuals and so apparent early in life that a few decades at most, with the normal wear and tear, are sufficient to bring to the surface evidence of the warped judgment and defective power of reasoning which form the essential features of the mental disorder.

The first step in the progression of the condition may be seen in the subject's early childhood. Commonly he is mentally precocious; he learns to walk and talk at an unusually early age. In rarer instances this part of the developmental process may be retarded. There are often noted in early life peculiar traits, shown by marked peevishness and irritability with a distinct tendency to fits of temper. Later he becomes moody, seclusive in habits and dreamy. He is usually hard to manage on account of his inability to appreciate the object of corrective methods. At school there is frequently a noticeable lack of desire to mingle with other children of the same age. In fact, not uncommonly the company of older individuals is preferred, on account of the flattery such children are apt to receive from adults, because of their apparent mental brilliancy. Such children may appear unusually studious, but substantial progress they do not make as a rule.

As puberty advances, a sexual element is apt to appear in the de-

velopment of morbid ideas based upon the sexual instinct. The reading of erotic tales may be preferred to the playground, thereby furnishing a field for the development of abnormal trains of thought. As the child grows into adolescence and maturity the angle of divergence becomes wider, and, totally incapable of meeting the struggle of life, his abnormal point of view and the peculiar emotional reactions are bound to result in maladjustment to his environment with consequent evolvement of the characteristic mental attitude. In addition to showing evidence of mental deviation there are commonly present one or more of the stigmata of degeneration.

Kraepelin,[1] in the eighth edition of his book, is willing to prophesy that, as the result of the tendencies in the analysis of cases presenting the paranoid syndrome during the last ten years, the paranoia concept may disappear. There has been an attempt to "dissolve the entire picture of paranoia" on the ground that it contains all the inventory of mania and represents the reaction of a manic-depressive type of person towards the effect of an exciting experience upon the emotional state.[1]

Etiology.—Developing upon a neuropathic foundation, paranoia is a mental anomaly rather than a disease and arises, by a process of evolution, as the product of an abnormal emotional temperament. The neuropathic disposition is likewise commonly found in the histories of the ancestors and collaterals of the subjects affected, although Kraepelin (1915) states that the history of neuropathy is uncertain. In one-fourth of the cases psychoses were recorded in the parents, or intemperance, or the parents suffered from some degenerative disease of the nervous system or defect of development. With regard to exciting causes it has been said that acute illness, intoxications, excessive mental stress and shock may play a part in the etiology. Granting that such be the case in some instances, it would seem that such factors play but a subordinate part compared with the predisposition.

Symptoms.—Since the mental state under consideration is a condition which is evolved with the mental development of the individual, it is a matter of great difficulty to decide when the disorder first becomes manifest. Most cases are of several years' duration before they are brought to the notice of the psychiatrist. The gradual, unnoticed exaggeration of the individual's peculiar mental traits, covering a number of years, usually does not attract the attention of those acquainted with the patient. On this account it can be stated that paranoia has its developmental period extending over a period of several years. There is a long prodromal period in which the symptoms may be very indefinite. During this phase of the disorder there is no indication of mental enfeeblement; there is no disturbance of memory in the ordinary sense of the word, and the reasoning power is not greatly impaired.

The mental condition may become apparent after the occurrence of a physical disturbance, or may seem to follow closely upon a period of unusual mental stress. The first symptoms may be largely subjective and objective, as sleeplessness, loss of appetite and malaise. With the development of hypochondriacal notions the patient loses his usual energy and ambition for work. Although always one naturally preferring his own company, he now becomes still more seclusive in habit, and begins carefully to study his own sensations, thoughts and aspirations. He is apt, through lack of sound sleep, to be disturbed by dreams; which are likely to be misinterpreted and form a part of his waking thoughts. He is apt similarly to misinterpret ordinary every-day happenings. During this period he is still able to attend to his usual duties after a fashion, and, although his actions may be accounted by his friends as being queer, he is not regarded as mentally unsound. Of all mental disorders the patients belonging to this class are the least communicative in regard to their thoughts and feelings. The absence of mental symptoms for so long a period may be due to the fact that the patient is able to cleverly mask his emotional reactions, so that it may be purely a matter of accident that he reveals his real thoughts to others. Usually it is not until the patient seeks relief in the confidence of a friend that a voluntary expression of his feelings is made, or some occurrence warrants the delusional interpretation and expression of his feelings which is the characteristic of the mental attitude of the paranoiac.

Perception for the most part is primarily unaffected. True hallucinations in the form of real sense deceptions do not take a part in the clinical picture. Dreamy visions may occur, especially at night, but are more apt to be mental distortions of real experiences in the daily life of the subject. The patient may believe that he has seen visions of "celestial origin" which seem to have some direct bearing upon events which have happened. On account of his suspicious attitude ordinary sounds of the street may be interpreted as directly intended to annoy him. The accidental glance of a passerby contains a look of scorn; a whistle or a cough may be interpreted as an insult. All of these are the outcome of his distorted attitude towards daily events rather than indications of sensory falsification.

As already indicated, there is a slowly developing system of **coherent delusion** with preservation of the orderly arrangement of the processes concerned in thought and behavioristic reactions. The delusive train is characterized by its egocentric (autopsychic) origin and development. Very gradually are gathered fragments of evidence which are pieced together to form a delusive system having at its foundation the **attitude** of an individual who is the object of maligning influences which follow him at every turn. At first the paranoiac is non-communicative; the matter is turned over and over in his mind; he is even willing at first to consider objections offered, should he

confide his suspicions to someone whom he still trusts. After he finds that none of his acquaintances share in his beliefs he rarely mentions them during the stage of **subjective analysis.** He spends most of his time dwelling upon his disturbing thoughts which become augmented by hypochondriacal notions and emotions. The patient may regard himself as the victim of a serious disease; that his mind is being tormented by others with the object of destroying his health and his reason.

The persecutory ideas now assume more definite shape and as the result of some chance experience he arrives at the conclusion that the Church or the Masons or other secret order is directing the persecution.

As the order of thought is that of the ordinary man, an explanation for the experiences is naturally sought by the subject. At this juncture he looks for additional evidence in support of his suspicions, which is invariably forthcoming on account of his attitude towards all commonplace experiences, which at the same time are explained in terms of jealousy, intrigue and conspiracy.

For a time the patient tries to avoid his supposed enemies by traveling from one place to another. Relief is only temporary, however, the result of the diversion of his attention from his abnormal emotional tone by the stimulation received through contact with new environmental experiences. Sooner or later the old emotions assert themselves, and evidence of the fact that his persecutors have followed him becomes manifest. He is now on the defensive, as he is unable to place the responsibility for his discomfort upon any definite person or group of persons.

The phase of persecution continues for long periods, during which the developing ideas which arise are known only to the patient. Eventually there appear in the attitude and behavior of the patient, perhaps for the first time in the development of the disorder, undoubted signs that he is entertaining expansive and grandiose ideas which centre about a **feeling of self-importance.** It is this feeling-tone, together with the individual's false view of natural happenings, that gives rise to the development of delusions of grandeur. He finds out, perhaps through " dreams " or " visions " or " secret messages," that he is a centre of attraction on account of his superior qualities; that by virtue of his greatness he is an object of jealousy and hate. The ideas of self-importance also arise out of the persecutory experiences to which the patient is subjected.

He reasons that if he is so widely persecuted it must be generally known that he is a great personage; that he must have been chosen to fulfil an important place in the world; that he is possessed of divine qualities.

Emotionally there is little external manifestation of disturbance beyond slight exaggerations which might be regarded as normal fluctuations until the disorder has become more or less fully developed.

Even then, in distinction to other paranoid conditions, the true paranoiac has an abundance of self-control. This, he reasons, is essential to prove to the world that he has been selected by a divine power to fill a place of importance in the world; that he was born to fulfil a special mission.

Memory processes show no disturbance in their fundaments. There is, however, a commingling of the delusive ideas and beliefs with happenings in the past life of the patient. The result is a **falsification of memory.** The patient recalls events in childhood to which are added fabrications. He recalls (?) events which have had no existence in reality, all of which, however, are necessary in the support of the delusive system.

Conduct.—During the early phases of the disorder the patient is apt to be depressed, hypochondriacal and irritated by his environment; hence he is loth to mingle in company or interest himself in the ordinary pursuits of life. During the persecutory stage he may show outbursts of anger; and, if by chance he is able to fix the source of his difficulties upon a definite person, he may prove a dangerous member of society. For a time he may seek to ameliorate his difficulties by an appeal to the courts for the suppression of the acts of his enemies. As the grandiose ideas become fully established he becomes self-satisfied and resigned to accept the interference with his rights as a necessary part of the process of education, which is to teach the world that he is the true Messiah, Emperor, Prophet or potentate of the new régime that is to rule the universe.

The various types of paranoia described by Krafft-Ebing, Magnan, Sander and others have as their foundation the mode of development, the content of the delusive system, the period of development and the character of the reactions. Thus, Krafft-Ebing divided the cases of paranoia into two groups: the early or original paranoia and the late or acquired paranoia, Sander being the first to apply the term *paranoïa originaïre* on the ground that it is truly a developmental condition, just as the normal mental organization is originated. On account of the delusional system being confined to a definite class of ideas, the term religious, querulent or litigious and erotic paranoias have been used.

From the standpoint of biopsychological interpretation of the condition and its mechanisms such subdivisions do not have an important place.

On account of the recognized difficulty in isolating the true paranoia, Kraepelin has decided to exclude from his group all of the cases described by Krafft-Ebing and Magnan, putting them into the *paranoid* group of dementia præcox cases.

In order to place those cases with paranoid trends, but without the disturbances of emotion and volition, and with more or less preservation of the personality, Kraepelin has constructed the group of *paraphrenias.* In other words, the paraphrenias comprise those cases which

can neither be classed as paranoid types of dementia præcox nor yet as true paranoia, hence the necessity for a class occupying an intermediate position.

Course and Prognosis.—As already indicated, true paranoia is a mental anomaly and therefore is a disorder of a lifetime. There are often periods of remission when the subject may be able to adjust himself more or less to environmental conditions, but even this apparent lull in his paranoiac reactions is to be attributed to the absence of visible obstacles to the fulfilment of his ambitions rather than any variation in his attitude.

Unless interrupted by some physical accident or disease the paranoiac settles down with the advance of years, at which time there may be a disorganization of the delusive system while only the paranoiac attitude remains. He may develop a secondary delusive system by which he is able to find shelter from persecution and treachery in the form of protecting influences which act as the means of enabling him to become resigned to his position.

For the differentiation of paranoia from paraphrenia we must refer entirely to Kraepelin's statements, that the two conditions are difficult to separate in the early stages. Kraepelin points out that the exalted *ego* is stronger if there is megalomania from the beginning in paranoia, and that there is more self-control in the paranoiac who uses only legal means of battle, and that the personality is not suppressed to the extent that it is in paraphrenia.

Diagnosis.—The diagnosis of paranoia is based upon the very slow onset and course, the coherence and systematization of delusions of persecution with falsification of memory, the change of personality, and the absence of clouding of consciousness and deterioration of the processes of thought for many years.

It may be necessary to differentiate paranoia from cases of manic-depressive psychoses with delusions. In these there will be indication of greater emotional instability, which is a more or less constant feature of the hypomanic state.

The paranoid type of dementia præcox in its early phase may present considerable difficulty. The important part played by hallucinations in dementia præcox, the signs of emotional and intellectual deterioration are the guides upon which the greatest dependence can be placed. In some cases the deterioration is so slow that it is impossible to make a differentiation until by further progress its presence can be established.

Paranoid States.—Mental conditions which superficially resemble paranoia have been noted by many observers. The paranoia-like symptoms which appear in the acute, recoverable psychoses have given rise to descriptions of *paranoia acuta* (Heinroth, Bianchi). These cases, upon closer examination, may be found to belong to other groups and therefore do not justify the isolation of special types of paranoia.

The term *paranoid state or paranoiac condition* is justifiable, however, if it be applied to those mental states which are characterized by the formation of more or less definite delusional systems of the persecutory type, with hallucinations of hearing and the retention of coherence of thought in many directions.

As already indicated, paranoid conditions are prominent in dementia præcox and in chronic alcoholism; also in paresis, epilepsy, presenile and senile psychoses, the hypomanic and in some depressive forms of manic-depressive psychoses and in both endogenous and exogenous toxic states.

Presenile delusional states, especially of the depressed type, are apt to develop paranoidal trends that are persistent and unshakable and which are regarded as giving an unfavorable color to the prognosis. For example, a patient in the sixth decade develops a depression in which he accuses himself of youthful sexual indiscretions; later he expresses fear of punishment and gives evidence of delusions of poisoning; upon the basis of disturbed organic sensations he believes that his health has been irrecoverably shattered and that he has but to wait for death. In the meantime, to explain the situation, he reasons that inasmuch as such radical measures have been employed conditions have arisen which have exceeded the calculations of his persecutors, hence they must devise means for covering their actions. To this end they are slowly administering poisonous substances in his food which are interfering with his thought-processes so that he is unable to communicate with his family or anyone who might come to his aid. Finally he settles upon an individual who is the agent of a "powerful paymaster," who directs all the activities against him.

Treatment.—The problem of treatment of paranoia resolves itself in most instances into the matter of determining first whether or not the patient requires institutional care and second what impression can be made upon the patient's emotional state in order to modify his attitude towards his environment. Paranoiacs are frequently not known as such until, on account of their reactions towards the subjects of their delusions, antisocial actions are observed. Clearly, then, it becomes a matter of interfering with the patient's liberty for the benefit of his environment.

In other cases in which, although the patient may be "harmless" from the viewpoint of society, it may be beneficial for him to be removed from the irritations of environmental influences and placed under conditions to which he may be able to adapt himself more easily, thus favoring the occurrence of a remission of active symptoms. From a purely medical standpoint there is practically nothing to be done in the matter of treatment of paranoia. From a medico-psychological point of view, one cannot say how much or how little can be accomplished until a trial is made. The principal difficulties lie in the fact that usually the condition has existed many years before coming

under observation, and that the patient regards himself as a well man and not in need of advice of any kind.

Careful, painstaking psychological analyses may furnish a clue to proper lines of attack from a psychological standpoint. Needless to say, it is useless to undertake any attempt at treatment until the confidence of the patient has been gained. On account of the dominating influence of the attitude of suspicion it may require months of contact with the examiner before that much can be accomplished.

In the paranoid states the matter of treatment is a more hopeful task. The mental state here is often a secondary condition and one that is dependent indirectly upon physical conditions requiring treatment. Here, too, the effect of mental analyses of the patient's condition are of utmost importance in order that the physician may be in the best position to meet the delusional trends with the hope of impressing the patient at the proper time with wholesome suggestions which may allay his fears and dispel his suspicions.

REFERENCES

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CHAPTER IX

PSYCHOSES WITH ORGANIC BRAIN DISEASE

REACTION TYPES INCIDENT TO CHANGES ARISING FROM DEGENERATIVE PROCESSES IN THE FINER STRUCTURES OF THE CEREBRAL SUBSTANCES, OR TO GROSS CHANGES IN LOCALIZED FUNCTIONAL AREAS.

Arteriosclerotic Psychoses.—The present group of psychoses includes the disorders which accompany arteriosclerotic changes in the cerebral blood-supply, which in turn may be brought about by changes in the vessel walls, due to long-standing toxic states and increased vascular tension. It is noteworthy that the condition of the radial and temporal arteries cannot be relied upon solely as an index of the condition of the vessels in the cerebral distribution. Advanced cerebral atheroma may be present with comparatively good radials and *vice versa*. Furthermore, it is impossible to define the point at which the symptoms dependent upon the more or less physiological changes of senility end and those due to arteriosclerotic processes begin. On the other hand, widely scattered gross brain lesions may exist without manifesting focal symptoms, thus presenting the clinical picture of simple senile atrophy. Thus one brain at autopsy showed nine distinct and separate areas of hemorrhage at intervals extending from the frontal pole to the lateral lobe of the cerebellum, yet the patient presented no focal symptoms.

Etiology.—The same factors operating in the production of arteriosclerosis elsewhere are potent in the cerebral cases. The mental symptoms, as has been pointed out at length previously, may be due to the general (systemic) effect of the arterial disease, or to the local involvement of the neuronic structures as the result of nutritional changes or gross destructive lesions. Inherited diathesis or a predisposition to arteriosclerosis appears quite prominent in some families.

Symptoms.—The mental manifestations of cerebral arteriosclerosis, without focal symptoms, are commonly of slow development; so that in some cases it is not until decided mental changes occur that the gravity of the condition is realized by the patient's friends. Unlike the other organic psychoses, much of the personality is preserved.

There is a prodromal period in which the patient complains of somatic disturbances which are the outcome of cerebral circulatory disorder, such as headache, dizziness, visual disturbance, tinnitus and deafness. General nervousness, somnolence during the day, insomnia at night, irritability, lack of capacity for mental work and a disinclination to take interest in new matters are the most conspicuous signs of the approaching mental disorganization. Commonly the patient notices that he is losing his ability to grasp new situations, that his

mental capacity is diminishing, the symptoms in general resembling a state of neurasthenia (Regis).

The gradually progressing mental and physical enfeeblement may be accentuated by attacks of excitement, depression, confusion or even a distinct delusional trend. The attacks may resemble confusional states seen in younger patients and, as later noted, are dependent upon a superadded toxic state (uremia). It should be noted also that the arteriosclerotic patient is especially susceptible to alcohol, often promptly developing mental confusion after taking a moderate amount of stimulant.

The emotional tone is decidedly affected in all cases. Emotional responses are often delayed on account of the patient's slowness to apprehend situations. Ill-timed laughter or weeping is not uncommonly seen in arteriosclerotic patients under real emotional stress.

Memory defects are among the most prominent indications of mental failure. Defects of memory involving recent occurrences are most marked on account of defective impressibility rather than on account of lack of retentive power.

The mental defect becomes more conspicuous with the occurrence of symptoms due to focal lesions—softenings and hemorrhages—such as aphasia, apraxia and palsies. Irritative cortical and subcortical lesions may give rise to epileptiform attacks. These seizures mark the occurrence of new hemorrhages or thromboses which are indicated by some added deprivation symptom which makes its appearance in the form of speech defect or an increase in the extent of the paralysis, following a convulsive attack. There is often a gradually increasing stiffness in the gait, or a tendency to lean strongly to one side, apparently due to a distinct weakness of all the muscles of one side without definite paralysis of any one portion of the body.

Pathology.—The essential pathological changes are the disintegrative effects of diminished blood supply to the cerebral substance and areas of softening *en masse* due to the thrombotic occlusion of vessels and cortical or subcortical destruction produced by hemorrhagic extravasations. The blood-vessels may be thickened throughout their course or in patches of atheroma, or, as is usually the case, both fibrotic and proliferative changes are seen in the same vessels. Microscopically there are changes in the nerve-cells, such as atrophy, increased pigmentation, vacuolation and defective staining qualities. The normal cell lamination in the cortex *is not disarranged*. Proliferative changes are also marked in the membranes. The pia is clouded and thickened. Where there is marked atrophy of the cortical substance there is an increase of fluid in the subarachnoid space. In the areas of the cortex, in which degeneration is most marked, and in the vicinity of the thickened blood-vessels, the proliferation of neuroglia is greatest. In long-standing cases with large destructive lesions of the motor area or of the region of the internal capsule there may be second-

ary descending degeneration in the pyramidal pathways of the spinal cord (Fig. 75).

Degenerative changes may not involve all of the medullated fibres in the tract, but many of the remaining fibres appear smaller in diameter than those in undegenerated paths. Depending upon the duration of the arteriosclerotic disease process, interstitial changes in the white substance may or may not be observed.

The various types of arteriosclerotic brain disease are recognizable anatomically rather than clinically. Their differentiation is based upon the location and extent of the degenerative process and the presence or absence of focal lesions. The principal anatomical types are:

1. **General arteriosclerotic atrophy,** which appears in mild and in

FIG. 75.—Bilateral descending degeneration secondary to arteriosclerotic softening in both internal capsules.

severe types. In the mild form focal symptoms may be wanting, but the subjective symptoms already noted are prominent, together with progressive mental deterioration without particular mental episodes or paralytic attacks. There is a gradual reduction in activity; speech may be reduced to a few set phrases without aphasic characteristics; memories fade rather rapidly; the patient lacks entirely the ability to form proper associations, and consequently disorientation is commonly present.

Physically these patients appear vigorous, are active and often restless. They may walk about aimlessly until exhausted, often carrying about an old rolled-up garment, or a bundle of papers, for which they can give no explanation of purpose. Some patients are still more active and in a more aimless manner, twisting and folding the bed-

clothes, rearranging articles of furniture in the room, until as the result of their efforts they get into remarkable tangles from which they are unable to extricate themselves.

These patients are usually quiet and good-natured, they babble to themselves and to others; with numerous gestures they may express their remnants of emotional experiences from which in child-like manner they may easily be diverted.

The progress of the disease is very slow in contradistinction to the more grave forms in which the atrophy progresses rapidly and reduces the patient to a mere vegetative existence. As noted in an earlier chapter, the reflexive movements now dominate the voluntary and inhibitory influences, as is shown by the patient's inability to let go of objects they have grasped. The patient will hold tightly the end of the bed sheet or the nurse's hand until some other reflexive movement is established and likewise becomes dominant.

The milder forms, which are the more frequent, slowly deteriorate mentally and physically. They require attention in the matter of all of their physical needs, continuing for years with a very slow downward progression until by a thrombosis or cerebral hemorrhage they become bedridden. Some patients survive several apoplectiform attacks, but, as a rule, are unable to survive the shock. Other patients develop a uremic condition with stupor, gradual elevation of temperature and exhaustion due to pulmonary œdema, congestion, bronchopneumonia or sudden failure of the myocardium.

2. Senile Cortical Softening.—This is the true "softening of the brain." As the name implies, this form of cerebral disease is characterized anatomically by the greater extent of the involvement of areas of the cortex as the result of disease in the walls of the blood-vessels supplying those areas. Sometimes an entire lobe, such as the parietal or temporal, may be destroyed as the result of vascular occlusion and secondary softening of the cortical substance (Fig. 76).

Symptoms.—The clinical picture presented is that of a slowly progressing mental deterioration, which is increased by larger increments as the result of the invasion of new cortical territories by the softening process and also by the addition of focal symptoms in the form of paralyses, sensory disturbances, cortical blindness and deafness and speech disturbance, due to thromboses of the cortical vessels. Premonitory symptoms already described in this chapter are those characteristic of slowly progressing arteriosclerosis of the cerebral vessels.

The mental symptoms, once definitely established, may be marked by periods of mental excitement, depression, confusion or stupor. Some patients develop distinct delusional trends of a paranoid type. Attacks of confusion are common; occasionally epileptiform seizures are the accompaniments of the invasion of new regions of the cortex, which may occur without signs of focal character as in the case mentioned in which there were nine distinct hemorrhages in the subcortex.

On account of the large amount of cortical territory affected by the disintegration process and the resulting functional deprivation, the patient is early confined to bed by reason of the paralytic condition which may involve portions of both halves of the body. The

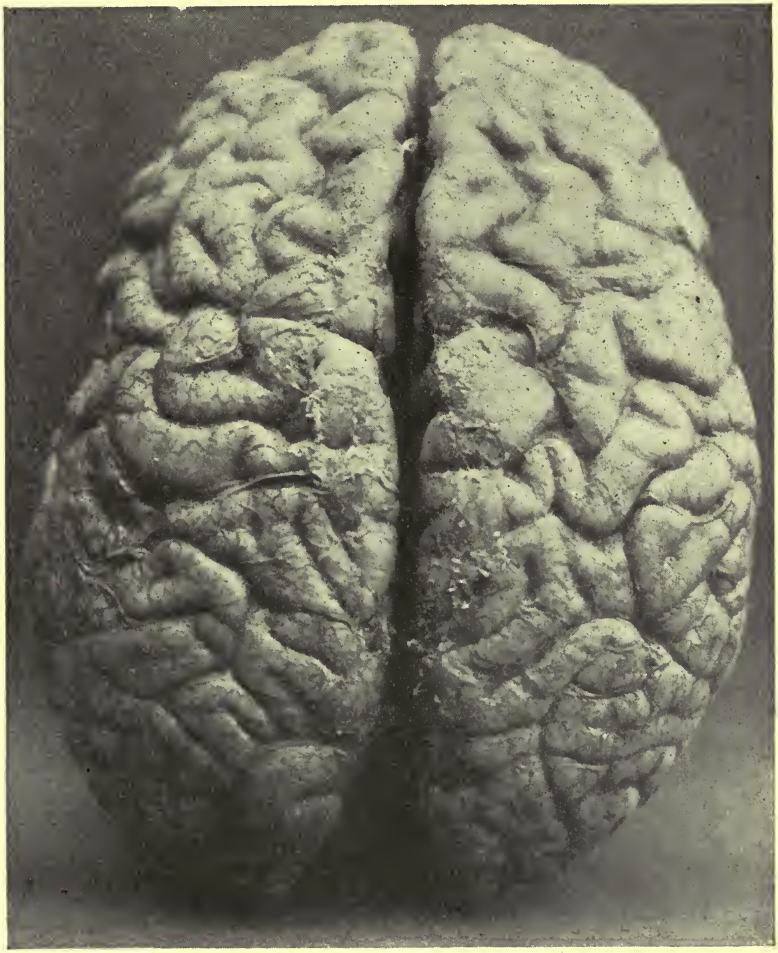

FIG. 76.—Cerebrum with area of softening in left hemisphere viewed from above.

patient becomes practically helpless, contractures appear and general bodily atrophy ensues. With the progress of the cortical distintegration signs of dementia advance rapidly until there is practically no capacity for thought.

Pathology.—Gross lesions are common in the majority of cases; areas of softening in the cortex, subcortical substance, and in the basal ganglia are distinguishable with the naked eye. Likewise, the arterio-

sclerotic changes may be seen in the larger cerebral vessels, especially in the basal arteries; some of the branches of the midcerebral may

FIG. 77.—Extensive softening in left hemisphere of arteriosclerotic cerebrum involving Broca's area.

show the occlusion, and the corresponding cortical areas of softening appear flattened, shrunken and often present a wrinkled appearance if of long standing (Fig. 77).

Microscopically the softened areas show destruction of the neuronic structures; the remaining nerve-cells present various stages of disintegration, the neuroglia is increased in the devastated areas, to which are added amœboid glia cells. The blood-vessels of the cortical substance have undergone thickening of the walls with corresponding narrowing of their lumina.

Treatment.—The treatment of the condition is that called for by the arteriosclerosis in general. Physical and mental rest; freedom from sudden mental and physical stress; careful regulation of the diet and the interdiction of stimulants are the chief indications. Alcohol almost invariably aggravates the mental irritability of the arteriosclerotic patient.

Attention should be given to the disorders which can be attributed to defective metabolism and to imperfect elimination on account of the accompanying nephritic defect usually present. The administration of alkalies and saline laxatives is important. For the insomnia and restlessness the bromides are usually sufficient.

Alzheimer's Disease ("Senium Præcox").—This disorder occurs most frequently in or soon after middle life and presents, as the name indicates, a premature condition of senility which progresses rapidly with mental deterioration and physical symptoms of general neuronic destruction.

Except for the progressive dementia, together with coincidental but not typical attacks of anxious excitement or depression with complete disorientation, the symptoms are largely the effect of cortical disintegration without signs of focal brain disease. The condition was first described by Alzheimer in 1906 as dependent upon a type of pathological changes not found in ordinary senile dementia and chiefly characterized by the microscopic picture of the widespread lesions.

Symptoms.—Usually the onset of the disease is gradual and may be marked by depression and agitation such as often initiate the depression of involutional melancholia. Soon, however, will be observed signs of true mental failure shown by memory loss and disorientation, with inability to recall words and difficulty in comprehending spoken language.

In many ways the speech disorder suggests that of the mental state in gross brain disease, but never is it as intense or as consistent as the speech disturbance of focal cortical disease. To this defect there is added a marked mental confusion which may amount to delirium. Physically there is lack of bladder and rectal control without true paralysis of the extremities with preservation of the general muscular strength, and considerable motor activity and restlessness. The motor symptoms are similar in some respects to those originating from gross brain disease though less marked and not corresponding with any definite anatomical seat of lesion.

Pathology.—According to the findings of Alzheimer, and subse-

quently of Bonfiglio, Sarteschi, Perusini, Binet, Bielchowsky and Fuller and Klopp,[2] the condition is characterized by the presence of microscopic masses of the products of disintegration of neuronic elements in the form of "miliary plaques." These masses are the result of the degeneration of the nervous elements and thickening of the glial elements which react towards the disintegrating material much in the same way as they would towards a foreign body. Encapsulation of the disintegration products results, giving rise to a snarl or bundle of fibrils where nerve-cells formerly existed. The presence of such structures, together with the Alzheimer types of cell degeneration is regarded as pathologically diagnostic.

Diagnosis.—Although the diagnosis of arteriosclerotic psychoses is rarely difficult, it may occasionally be necessary to use caution in the differentiation of psychoses due to arteriosclerosis from paresis and cerebral syphilis on account of the widespread character of the pathological process and the presence of progressive dementia in all of these conditions. The focal symptoms are usually prominent and more permanent in arteriosclerotic conditions. In the cases of late paresis the diagnosis must be largely based upon the laboratory findings. For example, a man sixty-two years of age, who for a number of years was a regular drinker of alcohol in large amounts, with peripheral evidences of vascular degeneration, developed expansive ideas, mental exhilaration, irritability and outbursts of anger. Physically, there were arcus senilis, unequal sluggish pupils, exaggerated tendon reflexes, speech difficulty (without alcohol) and muscular tremors. The diagnosis of arteriosclerotic brain disease complicated with alcohol seemed to be correct until the laboratory findings which were positive in favor of paresis closed the question.

Post-traumatic Psychoses.—The relation which traumatism and especially head injury bear to the psychoses is a question which presents considerable opportunity for discussion. As already stated in an earlier chapter, mental disturbance may be the immediate follower of an injury; the injury may act as a predisposing factor, especially with reference to psychoses in alcoholics; psychoses may occur after head injury in individuals of strong psychopathic predisposition; and, finally, psychoses may occur in persons who at some remote period have suffered a head injury, but in which there is no direct relationship from the standpoint of cause and effect.

As stated by Meyer,* the traumatic mental disturbance may be:

1. Direct post-traumatic deliria.—These may consist of deliria with or without fever due to meningitic or other traumatic reactions in the nervous tissue; the delirium which arises as the patient emerges from a state of coma which is often complicated by alcoholism.

2. The post-traumatic constitution.—This may act as an intensifier of the reaction to alcohol or disease toxins; or it may give rise to

* Loc. cit., chap. vii, part i.

vasomotor disturbances, such as headache, vertigo, mental irritability, sleeplessness, increased susceptibility to mental and physical fatigue, together with a general change in the mental characteristics and usually an increased susceptibility to the effects of alcohol; attacks of extreme mental irritability with outbursts of anger, the so-called "explosive diathesis"; attacks of a convulsive character either hysteroid or epileptoid, and finally paranoid conditions.

3. Traumatic defect conditions.—These are residual conditions which are the outcome of the injury to the nervous tissue and occur as aphasic conditions; mental deterioration with epilepsy and deterioration due to progressive changes in the tissues injured, which may or may not be aided by an already present arteriosclerotic process.

4. Psychoses in which the traumatism is only a contributory factor, *e.g.*, general paralysis, manic-depressive and other psychoses.

In strongly predisposed persons psychoses with epilepsy or, more correctly, epileptic seizures with prolonged post-convulsive mental disorganization may make their appearance. This has been observed in cases in which epilepsy developed several years after a head injury, and in which operative measures had been employed with a view to relieving the epilepsy by removing pressure from the cerebrum. Some patients present the mental symptoms both before and after the convulsive seizures.

As already noted in the discussion of alcoholic psychoses, the post-traumatic nervous condition is very frequently marked by an intolerance to alcohol.

Prolonged depressions, neurasthenic and psychasthenic states have been observed after head injury.

Head injuries received in early childhood are commonly given the credit of contributing to the development of a psychosis in the adolescent period. In looking for a cause for a mental breakdown in a youth, parents naturally lay great stress upon a fall out of a coach, or down a flight of steps, which may have occurred when the patient was but a few years old. If such relationship were to exist, there is no means of correlating the facts from the standpoint of cause and effect.

Huntingdon's Chorea.—This affection has as its foundation an organic disease of the central nervous system which usually begins in early adult life and very slowly progresses, leading to mental deterioration in the majority of cases. On account of its hereditary character the disease requires a peculiar predisposition for its development. Unlike many of the neuropathic conditions which in the Mendelian sense are recessive to the normal, the chorea of Huntingdon appears to be the result of dominant characters. Furthermore, the inheritance appears to be direct, in that members of a family who are free from the disease do not transmit the tendency to the disorder to their children.[3]

Symptoms.—In addition to the motor symptoms, which consist of involuntary jerky movements involving the face, neck and extremities which increase progressively in their severity, there are progressive mental symptoms, which in some instances terminate in dementia. Early in the disease the mental symptoms are mild in character and are indicated by a change in the patient's disposition rather than by distinct mental aberration.

The predominant mental symptoms involve the emotional tone. There may be a restless state of anxiety. The patient is irritable, morose and subject to outbursts of anger following periods of depression. In some instances there is a tendency to suicide, and occasionally homicidal tendencies are present. There is a gradually progressing mental sluggishness, with failure of memory and defects of judgment. Delusions are not frequent, but when present are apt to be persecutory in type.

Hallucinations are said to be infrequent and if present are unaccompanied by emotion (Diefendorf).[4] In some cases the mental deterioration is extremely slow; in fact, patients suffering from the disorder for many years may be able to conduct a business or profession successfully. The disease may last from five to thirty years. In some cases the marked mental symptoms may be transitory, while the dementia gradually progresses. The mental symptoms bear no definite relation to the severity of the motor disturbance. The disease usually terminates in death from an intercurrent malady or infection.

Diagnosis.—As a rule, the diagnosis is not difficult on account of the aid furnished by the family history. On account of the euphoria which exists in some cases there may be a resemblance to general paresis, particularly in chorea cases with marked speech involvement. The serologic reactions should clear the doubt which arises in the absence of pupillary signs and other typical symptoms of paresis.

Physically there are coarse, irregular jerky movements of the muscle groups of the face, neck and extremities. The bodily movements are awkward in appearance, but often are executed with surprising accuracy as in descending a flight of steps. The movements are of wide excursion, sometimes swaying the entire body. The speech is also jerky, often hesitating and indistinct.

Localized Neoplastic Lesions.—Cerebral tumors may originate in the brain substance or may involve the parenchyma by extension from the mesodermal substance, cranial bones or membranes, for the pathology and etiology of which the reader must be referred to works on general neurology. Brain tumors are sometimes found post mortem, without having produced symptoms during life, and doubtless still less frequent are active mental symptoms in the early phases of the disorder.

In patients with mental depression, drowsiness or mental clouding, to which are added headache, vertigo, nausea and optic nerve involvement, the presence of a cerebral new growth is quite probable. Later

mental symptoms may appear, irrespective of the site of the tumor. The character of the symptoms does, however, in some cases furnish localizing symptoms.

Hallucinations indicate invasion of one or more of the sensory areas by the growth or contiguous inflammatory reactions in the mem-

FIG. 78.—Acute hemorrhagic encephalitis (erysipelas). Infiltration of left lobe of cerebellum.

branes. Thus, if the olfactory region is included, hallucinations of smell may arise; likewise involvement of the occipital region may give rise to visual sense falsification and in the temporal region to auditory hallucinations.

Clouding of consciousness is present in some degree in the majority of cases, but varies greatly in degree, from that of mild torpor to marked somnolence. The severity of this symptom also varies con-

siderably in the same patient, probably dependent upon vascular changes and intracranial tension. Attention may be held with difficulty on account of the mental dulness, hence the patient's capacity for mental work may be greatly reduced. Memory is affected in so far as the patient is forgetful. This may be only apparent in some cases on account of the lack of interest which accompanies the mental dulness. Only in an advanced phase of the disease is the patient likely to be disorientated. Instances have been reported, however, in which there was a distinct Korsakow's mental syndrome, without the neuritic symptoms.

Emotionally some patients present an unnatural exaltation. They are silly, childlike and abnormally cheerful. In certain instances the patient presents the mental picture of the general paretic. Such cases present diagnostic difficulties in the absence of the cardinal symptoms of tumor.

In cases of long duration there may be a gradual mental reduction, finally reaching a state of dementia. Nonne states that this is possible only by a multiplicity of tumors and a well-marked hydrocephalus interna. This, however, must not be confused with states of stupor or coma which may arise as the result of increased intracranial pressure.

Attacks of excitement or depression are often associated with the paroxysms of headache, and likewise some of the mental sluggishness and depression may be the result of medication given for the relief of pain.

Diagnosis.—The diagnosis of brain tumor should be based upon the neurologic physical signs rather than upon the presence of mental symptoms. Convulsive seizures with or without transitory aphasia or paralysis may be significant of brain tumor, one of the forms of meningitis or paresis. The laboratory findings should be investigated from the standpoint of the *blood serum* and cerebrospinal fluid.

Brain Abscess and Inflammations.—As is true of brain tumors, the mental symptoms which accompany brain abscess are secondary manifestations. The symptoms may arise as the result of interference with intracranial circulation and rise of pressure, or to accompanying meningitic processes or to the absorption of toxic infectious materials. The symptoms are usually either those of delirium or stupor and are accompanied by general symptoms and physical signs of acute intracranial disease (Fig. 78; see also frontispiece).

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CHAPER X

PSYCHOSES OF THE SENILE PERIOD

REACTION TYPES OF MIXED CHARACTER OCCURRING IN THE INVOLUTIVE PERIOD DEPENDENT UPON REGRESSIVE, FUNCTIONAL NEURONIC CHANGES.

THE study of the mental disorders of old age in the past few years has given rise to some modification of the generally accepted notions in regard to senility, while some others have been entirely discarded. Most of the changes in viewpoint have been founded upon an anatomico-pathological basis. It was formerly considered physiological that mental changes, giving rise to distinctly abnormal mental reactions, should occur as the effect of old age alone. On the other hand, the comparatively few individuals who reach advanced age with mental powers apparently clear, with dependable memories and amiable dispositions, maintained as in their earlier years, were considered as of the exceptional type. This point of view has to-day few supporters. On the contrary, the whole-minded "aged" persons who seem to furnish the exceptions are in reality regarded as examples of normal senility. The departures from this, commonly met, may be considered as pathological types. The individuals who have reached the "ripe old age" with mental powers intact are the possessors of an heritage in the form of a stable nervous system and have had the good fortune to escape those diseases which seriously damage the vascular and parenchymatous structures of organs concerned in the metabolic processes.

The pathological group of seniles is to be found among those individuals who, either because of bad heredity or a disregard of the principles of hygiene or long-standing ill-health, wear out early either physically, mentally or both. In such persons one may detect, earlier than usual, evidences of retrograde metamorphosis as indicated by premature grayness of hair, sallow and wrinkled skin, thickened palpable arteries, arcus senilis, increased vascular tension and diminished myocardial tone.

The question of what is to be considered as the senile period is best answered upon a basis of anatomical criteria rather than upon a definite age limit. Senility is therefore to be regarded as a relative term and as dependent upon regressive tissue changes, especially in the structural elements of the vascular system; some individuals are senile at a comparatively early age, while others maintain their physical and mental vigor late in life.

That some persons are precociously senile has long been recognized;

the picture of early physical senile changes together with mental senility has been described under the heading of Alzheimer's disease.

Etiology.—Arteriosclerosis is a recognized etiological factor in the mental disorders of old age and, on the other hand, is found without mental disorder in the majority of instances. Bolton regards the mental symptoms in many general arteriosclerotics as dependent upon imperfect nutrition and secondary intoxication from the accumulated products of metabolism and dissolution. The process is distinctly a degenerative one in that there is no progress in the direction of reparation. With the advance of the degenerative change in the cerebral vessels, hemorrhages, thromboses and softening may occur characteristic of the true arteriosclerotic types of mental disease which have been described in the previous chapter.

The group of senile mental disorders included under the term **senile dementia** is properly restricted to a single class, namely, those patients whose mental deterioration is dependent upon atrophy of the cerebral substance without preceding infiltration, inflammation, hyperplasia, vascular degeneration, sclerosis or softening. Such cases are comparatively uncommon. Southard [1] reviewed forty-two cases diagnosed as senile dementia, reconsidering them clinically and anatomically, and found that from the standpoint of either cerebral atrophy or arteriosclerosis there were but 66 per cent. of the cases in which the diagnosis was accurately made from the clinical point of view. In instances in which cortical arteriosclerosis alone was considered essential for a diagnosis, the percentage of accuracy in diagnosis was 48 per cent. and only 38 per cent. in which cerebral atrophy was considered essential. Southard found fourteen cases without either atrophy or arteriosclerosis (cerebral) which he regarded as belonging to a group of acute mental disorders not dependent upon senile changes. Of the remaining cases there were but eight of "relatively pure brain atrophy representing the more genuine senile dementia than the arteriosclerotic cases, which should be classed as 'organic dementia.'" He regards as true senile dementia or atrophic dementia those examples in which the loss in brain weight proceeds with the general loss in weight in other viscera and cases in which the loss in weight in the nerve tissues is differential and accordingly concludes that the mental diseases of old age may be divided into the three following groups:

(*a*) Mental diseases occurring in but not characteristic of old age.
(*b*) Organic dementia due to cerebral arteriosclerosis.
(*c*) Senile atrophic dementia, attended with
  (1) general visceral atrophy.
  (2) differential atrophy of the nerve tissues.

Simple senile dementia differs clinically from the arteriosclerotic or organic type chiefly in the absence of the general physical symptoms. Compared with the simple atrophic dementia the onset is somewhat abrupt in the arteriosclerotic. That is to say, following a more or less

indefinite prodromal period showing faulty memory and inability to acquire new mental habits, a vertiginous or syncopal attack is followed by accentuation of the mental enfeeblement. In the atrophic dementia the onset is very much more indefinite and the development likewise slow. There is usually some sense of realization of the mental difficulty on the part of the arteriosclerotic patient, while the pure senile considers his mind as dependable as ever. The emotional states of the two conditions present differences. Irritability is present in both, but emotional instability with alternate weeping and laughter without adequate reason belongs to the dementia of arterial disease. In simple seniles a syncopal attack adds little if any immediate effect upon the mental state. Transitory attacks of mental confusion with hallucinations are common in sclerotics, in which by reason of imperfect elimination there is distinct evidence of toxicity, either the result of gastro-intestinal or renal insufficiency; for the same reason attacks of transitory stupor are common in organic dements. Fixed delusions are not common in arteriosclerotics except in hallucinatory cases in which the toxic element is greater than the degenerative process. In atrophic dements delusions of a persecutory type are frequent.

Symptoms.—In the more insidious cases patients first show a hesitancy to take up new duties; they tire easily upon attempting continued mental application. Mental irritability is a frequent symptom and commonly is associated with emotional instability, uncontrollable weeping or laughter often alternating. The mental change constitutes an irreparable mental void; the principal symptoms show a loss of memory and mental energy with impairment of thought and directed action, with or without stupor, resulting in progressive and ultimately total mental failure—a true dementia.

For comparatively brief periods the picture may suggest prolonged mental depression or excitement often symptomatically termed "senile melancholia" and "senile mania." These syndromes are only the forerunners of the more serious condition and are apparently due to the toxic condition already mentioned.

Hallucinations are not common in the true atrophic senile dement. Commonly there is an associated deafness which leads the patient to misinterpret auditory impressions. Similarly there may be illusions of the other senses, especially of the various forms of cutaneous sensibility.

Memory is defective for recent events, yet with considerable tenacity of memory for recalling events of the remote past. This is due to the fact that at first there is little clouding of consciousness, but the power of impressibility is feeble or lacking. Happenings of an hour ago are forgotten while events of the patient's youth are easily recalled, but often only to be confused with present occurrences.

In some instances this memory default appears to be the fundamental defect. Two sisters observed by the writer presented as the first indication of mental failure a loss of memory which eventually

became absolute so that not only the impressibility but also the power of retention and recollection were absent and the patients thus were rendered practically incapable of connected thought.

Usually, however, with memory of remote events retained, the patient lives in the past, and because of his inability to reconcile his mental processes with the facts of environment his thoughts become self-centred.

Delusions, if present, are observed in the earlier phases of senile dementia, and are apt to be persecutory in type, as has already been described under the paranoid form. Occasionally a paranoid trend may supervene as the precursor of senile mental decay. In such instances delusions of a persecutory type develop upon a basis of morbid suspicion strengthened by hallucinations of hearing, taste and smell. Such mental states are of diagnostic importance from the medico-legal standpoint. Commonly the mental disturbance leads to misinterpretation of the actions of persons in care of the patient. Occasionally we meet with elderly persons in whom there appears to be fairly systematized, fixed delusive ideas, especially with regard to the attitude of certain members of the family. A devoted child may be accused of cruelty towards the parent, or of planning to get control of the patient's estate. Such delusive ideas may give an unjust reason for the alteration of a will by the patient. On account of the falsification of taste and smell the patient may believe that attempts are made to poison him. He will often refuse to take food, or may actually accuse his caretakers of poisoning his food. Usually there is someone who for a time is able to gain the confidence of the patient, and, if a designing person, might easily take advantage of an opportunity to influence the patient in the making of his will to the advantage of the former and the disadvantage of the rightful heirs.

Psychomotor disturbance is the rule. There is usually a more or less marked degree of motor restlessness; the patient wanders aimlessly about the house, moving furniture about, carrying clothing or ornaments from one room to another, especially at night. With a marked memory defect there is commonly disorientation for time, persons and place. He calls strangers by familiar names and misnames members of his own family. Although occupying the house in which he has spent the greater part of his life, he speaks of "returning home." On this account he wanders out of the house and soon becomes hopelessly lost. Sleeplessness and restlessness are, as a rule, troublesome features; frequently these patients sleep during the day after a night of incessant activity, only to repeat the same each night.

The **emotional tone** is subject to marked fluctuations. Many patients are depressed, irritable, peevish and subject to outbursts of anger. Matters which do not concern the patient's comfort make no impression upon him except to irritate and arouse his anger. He becomes intolerant to changes from the usual routine of life and his attitude

towards those about him now indicates that he has lost all consideration of the comforts of others, insisting that his impossible demands be carried out.

Not infrequently there is an abnormal sexual desire which gives rise to obscene language and indecent acts, and not uncommonly to attempts at masturbation. This is doubtless due in old men to irritation produced by prostatic disease, which also accounts for the attempts at sensual love-making and, as occasionally occurs, attempts at intercourse with children.

Course and Prognosis.—The course of the disorder is usually prolonged unless interrupted by some intercurrent physical disease. The dementia advances slowly and may continue from two to five years. Physical enfeeblement advances with the mental deterioration. Finally the patient is unable to help himself; urine and feces are incontinent, and the patient must be kept in bed. Gradual impairment of all the vegetative functions progresses. The patient may pass into a stuporous state from which there is no emergence, and death ensues from general asthenia.

Functional Types.[2]—Some seniles experience attacks of mental disorder from which they recover. These patients appear to be suffering from the mental effects of disordered function brought about indirectly by systemic arterial disease. One individual with "pipe-stem" radials and diseased cerebral vessels, even to the extent that he may suffer the common vascular accidents, such as hemorrhage or thrombosis, may nevertheless show no mental symptoms except those due to deprivation, as in the amnesias and aphasias. On the other hand, the person with the necessary predisposition and with moderately fibrotic systemic vessels, without physical evidence of focal cerebral vascular disease, may be the one who suffers from the psychosis. In these latter cases there appears to be a greater toxic factor and a lesser degree of nutritional cerebral disturbance so that the nervous structures appear to be able to withstand any tendency to degeneration long enough to allow the toxic agent to be eliminated, hence recovery takes place. Naturally, if the action of the toxins is of sufficient duration, with the lowering of the resistance of the neuronic elements, and if the vascular changes were to progress sufficiently, there would follow permanent neuronic damage and irreparable mental loss.

It must here be stated that often these patients do not suffer from the common subjective symptoms of arteriosclerosis, either because the pathologic process is not far enough advanced, or the disordered mental state may mask the symptoms which would be complained of by the mentally normal individual.

Concerning the nature of the toxins at work, we must still plead ignorance. It may be said that systemic arteriosclerosis is present, and if the sclerosis is of sufficient grade and duration, changes will have taken place in the parenchyma of the viscera supplied by the

diseased vessels. Toxins thereby will be generated at an abnormal rate or insufficiently eliminated, owing to the insufficiency of the affected viscera. In this way and thus far only, can one say that there probably is an indirect relationship existing between the arterial disease and the toxic condition. Experimental evidence indicates that some relationship exists between the sex glands and the adrenal glands, and that in the period of climacteric involution the atrophy with cessation of function of the sexual glands is accompanied by an excess in functional activity of the adrenals. It is also established that injection of adrenal extract into the circulation not only is followed by rise in blood-pressure, but lesions of the blood-vessel walls of animals can be produced experimentally by repeated injections of adrenin. If this were proved to be a constant factor in given cases, a basis for explaining the pathogenesis of the psychoses at and after the climacteric might be provided (Lugaro).

Furthermore, we have to deal with individuals with an inherited or acquired low resistance on the part of the nervous system, who react unusually to the accumulated toxins, with effects manifested by mental symptoms. The appearance of the psychosis is dependent upon the manner in which the nervous organization reacts to an altered quality rather than upon quantitative changes in the cerebral circulation.

Symptoms.—In conditions arising on a toxic basis the onset of the disorder is apt to be acute. Clinically the chief mental symptoms are those of **confusion,** approaching the character of a delirium, with disturbances of the mental sensory sphere, as active hallucinations of hearing, vision, taste and smell. The hallucinations are commonly of an unpleasant character and furnish in many instances a basis for motor and mental unrest. On account of the mental confusion the patient is unable to appreciate where he is, the time of day, or month, or year, and is unable to recognize persons about him (disorientation). The attacks with sudden onset may run a shorter course of a few months with final restoration to mental health and improvement in the physical condition. Some patients with moderate confusion but with active hallucinations give expression to delusive ideas of impending danger and persecution, depending upon the character of the sensory disturbance. In this class of patients recovery is slower than in the confusional cases, doubtless due to the profound impression made upon the mental sensorium, just as, in the normal mind, a vivid dream may leave its impression upon the emotional tone and thoughts for a considerable length of time.

In some instances the onset of the attack is more or less subacute, characterized by a profound depression, delusions of poverty, personal unworthiness or sinfulness and with a strong tendency to suicide. In other instances the delusions are the outcome of a somewhat systematized reasoning process and appear to arise from physical discomfort, such as a sense of general bodily distress with numbness, tingling

or burning cutaneous sensations, epigastric discomfort, thoracic oppression or distress in the throat with difficulty in swallowing and difficult speech (non-paralytic). The patient may express himself as feeling as if something had closed his throat so that he cannot swallow, and may cause the patient to refuse food. In some cases there is tinnitus and dizziness, especially in the markedly arteriosclerotic. The tongue is heavily coated, the mouth dry, the breath fœtid, the skin dry, harsh and sallow, the bowels obstinately constipated; the urine is scanty, as a rule, containing an excess of phosphates, urates, oxalates and usually indican in excess. The course of the disorder in this class of patients is longer than that of the confusional types. Often there is a period of tedious convalescence during which there persists an idea of indefinite personal inadequacy with a feeling of hopelessness of future recovery. A gradual disappearance of that attitude on the part of the patient and the replacement of the morbid thoughts one by one is the rule in the recoverable cases.

Finally, there is a third group of the functional senile psychoses, namely, the recurrent forms. These belong to the manic-depressive type. Individuals of strongly neuropathic tendencies and hereditary predisposition, who have suffered one or more attacks of mental excitement or depression, comprise this group. The arterial changes, if present, are purely coincidental and may serve as contributing factors in the same way as in the other classes of senile disorders.

In some instances the patient may have suffered several attacks of mental disorder in early life, and just prior to the final attack may have failed considerably in health and on account of a rapidly increasing infirmity may succumb. Again with advancing age the mental attacks usually increase in frequency and the intervals become shortened so that with practically no lucid intervals the condition continues as a chronic mania or depression until the patient dies of some intercurrent organic affection.

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GLOSSARY

ABOULIA.—An hysterical symptom characterized by absence of will.

ACCESSORY CHROMOSOME.—An odd chromosome found in only one-half of the spermatozoa in some animals. See sex-chromosome and x-chromosome.

ACCIDENTAL PSYCHOSES.—Psychoses which appear to be largely the result of external causal factors, as opposed to psychoses occurring as the result of strong predisposition.

ACHROMATIC SPINDLE.—The spindle-shaped arrangement of non-staining threads seen during mitotic division, constituting the lines of movements of the chromosomes.

ACHROMATIN.—The non-staining material in the cell nucleus in contrast with the chromatin.

ACQUIRED CHARACTER.—A characteristic which owes its causal factors to environment.

ADAPTATION.—The adjustment of an organism to environmental conditions.

ADAPTIVE REACTIONS.—Activities of organisms which are essential for adjustment.

"ADJUSTOR."—A term given to the central nervous system in lower organisms.

AFFECTION.—The general term for emotional reactions.

AFFECTIVE STATE.—The reactive attitude of the individual towards experience.

ALLOPSYCHIC DELUSIONS.—Morbid beliefs referring to persons other than the patient.

AMPHIOXUS.—One of the simplest types of organism possessing a rudimentary vertebral column (notochord).

AMNESIA.—Literally, without memory; loss of the ability to reproduce mental experience (memories).

ANISOCORIA.—Inequality of the pupils.

ANNELIDS.—A class of worms with ring-like body segmentation and a ganglionic type of nervous system.

APRAXIA.—A mental state analogous to that of aphasia, marked by the inability to reproduce the movements necessary for the performance of certain acts.

APPERCEPTION.—The mental process through which percepts and other experiences are made mentally clear.

APPREHENSION.—The comprehension of facts of environment without the aid of direct attention.

ARTHROPODS.—Animals constituting a large phylum, including crustaceans, spiders and insects, characterized by body segmentation and jointed extremities.

ASSOCIATION.—A mental process by which experiences are made the subject of comparison or contrast.

ASSOCIATION PATHS.—Tracts of white matter constituting connections between several cortical areas.

ASTROCYTES.—Neuroglia cells (also named spider cells), with radially arranged fibrillar processes; the type found proliferating in the cortex in degenerative changes.

ATAVISM.—The tendency for inherited traits to appear in grandchildren, though absent in the parent.

ATTENTION.—The voluntary or involuntary selection of response which determines the attitude of the individual towards environmental stimuli.

ATTITUDE.—The behavioristic reaction of the individual towards the effects of stimuli.

AUTOMATIC ACT.—An act of the volitional type performed without the aid of consciousness.

AUTONOMIC NERVOUS SYSTEM.—Literally the independent nervous system; applied to the nervous mechanism controlling involuntary muscles and glandular structures.

AUTOPSYCHIC DELUSION.—Morbid belief referring to the self or personality of the patient.

"AVOIDING REACTION."—The tropistic movements of lower organisms by which they withdraw from unfavorable environments for more favorable ones.

AXON.—The axis-cylinder process of a nerve cell.

BEHAVIOR.—The reactions of an organism as a whole.
"BIOGENE."—The hypothetical molecules of protoplasm concerned in metabolism, particularly in oxidation in cells.
BRACHYDACTYLISM.—The anomalous condition of having abnormally short digits.
BULBAR.—Relating to or originating in the bulb (*medulla oblongata*).

CALAMUS SCRIPTORIUS.—The region of the fourth ventricle formed by the divergence of the posterior funiculi in the medulla.
CALCARINE FISSURE.—The cerebral sulcus forming the inferior boundary of the cuneus.
CARPHOLOGIA.—Picking at the bed-clothing or other objects, as occurs in states of profound exhaustion.
CATATONIA.—A motility disorder, characterized by disturbance of general muscular tension.
CENTROSOME.—The refractile body marking the center of radiation of intracellular activity during mitotic cell division.
CEPHALOPODS.—A class of mollusks, including the squid, cuttle fish, and octopus.
CEREA FLEXIBILITAS.—Waxy flexibility. A plastic state of bodily mobility in which the limbs may be moved to any fixed position.
CEREBRAL GANGLIA.—The nervous masses in invertebrates corresponding to the brain of the vertebrate.
CEREBRAL PEDUNCLES.—The masses of nerve tissue forming the junctions of the pons varolii with the hemispheres.
CESTODES.—A class of flat worms with functionally independent segments and without an intestinal canal.
CHORDA DORSALIS.—The rod-like cellular mass forming the foundation of the embryo vertebral column.
CHORDATA.—The highest phylum of the animal kingdom, which includes all animals possessing a chorda or vertebral column.
CHROMATIN.—The nuclear material, which possesses a strong affinity for basic stains, in contrast with achromatin.
CHROMOSOMES.—The deeply staining bodies in the cell nucleus seen during mitotic division.
CLOUDING OF CONSCIOUSNESS.—The morbid mental state in which stimuli fail to produce clear impressions.
CNIDOCIL.—The filamented sac-like defence organs of cœlenterates.
CŒLENTERATA.—The phylum of the animal kingdom, which includes hydras, jellyfishes, and sea-anemones.
CŒNESTHESIA.—"The general feeling which results from the state of the entire organism" (Höffding).
COMPULSIVE ACTS.—Reactions which seem to be forced upon the patient without any conscious effort.
CONDITIONED REFLEX.—A reflex arising as the result of a stimulus which is substituted for the normal or physiological stimulus.
CONDUCTOR.—The neuron situated between the receptor and the effector.
CONJUGATION.—The pairing of paternal and maternal chromosomes prior to the maturation division of the parent cells.
CORPUSCLES OF VATER.—Tactile receptors in the subcutaneous tissues and the deeper connective tissues of vertebrates.
CROSS-FERTILIZATION.—Fertilization of one variety of a species with germinal material from another variety.
CUNEUS.—The wedge-shaped lobe of the cerebral hemisphere containing the neurons of the optic radiation; the area for half vision.
CYCLOPEAN MONSTER.—A monstrosity with a fusion of both optic vesicles to form a single eye.
CYCLOSTOMES.—Eel-like animals without functional jaws, having a suctorial mouth, a single olfactory organ, and without paired fins.
CYCLOTHYMIC PSYCHOSES.—Mental disorders characterized by the more or less periodic occurrence of emotional disturbance, as in manic-depressives.
CYTOPLASM.—The protoplasm of the cell exclusive of the nucleus.
CYTOSOME.—The cell body.

DALTONISM.—Color-blindness in which one is unable to distinguish red and green; a sex-linked characteristic usually appearing in males.
DEGENERACY.—The inability to transmit normal inherited characters.
DEMENTIA.—Mental enfeeblement, due to the irrecoverable loss of one or more mental functions.
DEPRESSION.—An emotional state characterized by mental discomfort, and retardation of thought and action.
DERMATOGRAPHIA.—The persistence of hyperæmic markings traced upon the skin, due to vasomotor instability.
DETERIORATION.—Permanent mental impairment.
DETERMINANTS.—The units of heredity (Weismann).
DETERMINER.—The factor in the germ cell upon which the development of a trait or character depends.
DIFFERENTIATION.—The process of producing specific parts or substances from a general part or substance (Conklin).
DIFFERENTIAL SENSITIVITY.—The property by which organisms are enabled to respond to different kinds or degrees of stimulation.
DISSOCIATION.—The failure to unite experiences with the personality (Janet).
DISORIENTATION.—The inability to recognize one's position with reference to time, place or person.
DISTANCE RECEPTORS.—Sense organs for the reception of physical stimuli without actual contact with objects of sense. *e.g.*, light and sound receptors.
DISTRACTIBILITY.—A disorder of attention arising out of compulsory reactions to accidental stimuli.
DOMINANT CHARACTER.—A character inherited from one parent which develops to the exclusion of a contrasting character of the other parent.
DROSOPHILA.—A genus of fruit-fly.
DUPLEX CHARACTERS.—Characters that are determined by factors derived from both parents.

ECHINODERMS.—A phylum of sea-water animals, including sea-urchins and star-fish.
ECHOLALIA.—The repetition as in mimicry of spoken words heard by the patient.
ECHOPRAXIA.—The repetition as in mimicry of the actions of persons seen by the patient.
EFFECTOR.—The muscular or glandular structure which is stimulated to activity by an appropriate excitant.
EMOTION.—The complex of responses accompanied by more or less definite feeling tones which determine the attitude of the individual towards experiences.
EMOTIONAL ACT.—A motor response of the individual as a whole, determined by an affective state.
EPIGENESIS.—The doctrine which holds that the germ cell is homogeneous, and that development depends upon environmental changes.
EUPHORIA.—The feeling of well-being.
EXTEROCEPTIVE RECEPTORS.—Organs for the reception of external or physical stimuli.

FABRICATION.—A memory disorder in which pseudo-recollections are related as experience.
FACTOR.—A specific germinal cause of a developed character (Conklin).
FERTILIZATION.—The union and mixing of the chromosomes of the male and female sex cells.
FLIGHT OF IDEAS.—The abnormal rapidity of the flow of ideas with frequent change of the object of thought.
FOLIE DU DOUTE.—A psychoneurosis characterized by obsessions of doubt.
FORCED MOVEMENTS.—Movements dependent upon tropistic reactions.

GAMETE.—The mature egg or sperm cell.
GERM CELL.—The male or female sex-cell.
GERM-PLASM.—The material basis of inheritance (Conklin).
GOAL IDEA.—The terminal idea in a normal train of thought.
HALLUCINOSIS.—A morbid mental state, in which hallucinations constitute the dominating symptom.

HEBEPHRENIA.—One of the dementia præcox types, marked by early mental deterioration.
HELIOTROPISM.—The attraction of organisms towards the light.
HEMERALOPIA.—The visual defect in which one experiences difficulty in seeing clearly in subdued light; night-blindness; more accurately termed nyctalopia.
HEREDITY.—The appearance in offspring of characters whose differential causes are in the germ (Conklin).
HETEROZYGOUS.—Derived from hybridization or cross breeding.
HISTOGENESIS.—The developmental origin of differentiated cells.
HOMOZYGOUS.—Derived from the union of germ cells which are similar in hereditary characteristics.
HORMONE.—A substance in an animal body which stimulates functional activity.
HYBRID.—The offspring of parents possessing different characters.
HYDRA.—An aquatic animal belonging to the cœlenterates of the lower forms.
HYPERPROSEXIA.—The absorption of the attention by a single idea or object of thought.
HYPERSUGGESTIBILITY.—An abnormal tendency to respond to accidental stimuli.
HYPOMANIA.—The mildest form of manic attack.

IDEA.—A mental image; a concept.
IDEATION.—The process of the formation of ideas.
IMAGINATION.—The mental process similar to memory processes through which mental images are formed by a rearrangement of memories of former experiences, accompanied by a feeling of strangeness or unreality.
IMPULSIVE ACTS.—Acts depending upon instinctive reactions which are not controlled by the subject.
INDUCTION.—A modification of the first filial generation caused by the action of environment on the germ cells of the parental generation (Conklin from Woltereck).
INHERITED CHARACTER.—A character the differential causes of which are in the germ (Conklin).
INSTINCTS.—Complex reflexes which serve in adaptation to environment.
INSTINCTIVE ACTS.—Acts which give rise to the accomplishment of a given end without previous knowledge of the result, and without previous training with reference to the act (James).
IRRITABILITY.—The capacity of organisms to receive and react to stimuli.

KINÆSTHETIC SENSATIONS.—Sensations which are derived from the bodily movements (muscles, joints, tendons).

LIMULUS POLYPHEMUS.—One of the crustaceans; the "horse-shoe crab."

MANIA.—A state of mental excitement, accompanied by emotional exaltation and excessive activity; the manic phase of the manic-depressive psychoses.
MANNERISMS.—Modifications of the normal movements of the patient.
MATURATION.—The stage in the development of the sex cells, during which the number of chromosomes is reduced one-half.
MEMORY PROCESSES.—The mental processes concerned in the reproduction of mental experiences.
METAZOA.—Animals composed of many cells, in contrast with unicellular organisms.
METRIDIUM.—A variety of sea anemone.
MITOSIS.—Indirect nuclear division of cells, having as its prominent characteristic a series of changes in the chromatin mass.
MUTATIONS.—Inherited variations; characters that are new to the stock.
MYELINIZATION.—The process of development of the fat-like substance investing the axis cylinders of some nerve fibres, constituting the myelin sheaths.

NEGATIVISM.—The involuntary resistance to external stimuli seen in dementia præcox and allied mental states.
NEMATOCYST.—A defence organ of hydra and other cœlenterates.
NEOLOGISM.—Coined words or meaningless terms, as "nunce plant."
NEURAL CANAL.—The lumen of the neural tube.
NEURAL CRESTS.—The aggregation of embryonal cells which give rise to the neurons of the spinal root ganglia.

NEURAL GROOVE.—The dorsal groove of the vertebrate embryo, which marks the beginning of development of the brain and spinal cord.
NEURAL TUBE.—The cellular-walled tube formed by the closure of the neural groove.
NEURILEMMA.—The external sheath of a nerve fibre, best developed in peripheral nerves.
NEUROBLASTS.—The cells of the neural tube from which the nerve cells originate.
NEUROGLIA.—The supporting tissue of the nervous system of epiblastic origin.
NEUROMERE.—One of the segmental divisions of the neural tube marking the somatic distribution of a spinal nerve.

OLFACTORY TRACT.—The tract of nerve fibres originating in the neurons of the olfactory lobes of the brain.
OÖGENESIS.—The development of the ovum from a primitive sex-cell.
OÖSPERM.—The united egg and sperm cell.
ORGANIC DEMENTIA.—Mental enfeeblement due to permanent structural changes in the central nervous system.
ORGANIZATION.—Structural and functional differentiation of the parts of an entire organism.
OSCULA.—Pore-like openings in the bodies of lower metazoa, *e.g.*, sponges.
OTOLITH.—An ear stone or auditory ossicle found in the simple forms of auditory apparatus; a concretion contained in an epithelial sac, containing sensory cells; also an organ of equilibrium.
OVUM.—The female sex-cell.

PACINIAN CORPUSCLE.—Bulb-like tactile nerve endings (receptors) in the subcutaneous and other connective tissues in vertebrates, described by Pacini.
PAPILLŒDEMA.—Swelling of the head of the optic nerve found accompanying increased intracranial pressure.
PARAMECIUM.—A ciliated one-celled organism.
PARTHENOGENESIS.—Development of an egg without fertilization.
PHOTOTAXIS.—The reaction of an organism towards light stimuli.
PHYLOGENETIC.—Pertaining to the development of a species or race.
PHYLUM.—One of the principal divisions of the animal kingdom, *e.g.*, protozoa, chordata, etc.
PISUM SATIVUM.—The edible pea; the variety used by Mendel in experiments in hybridization.
PLATHELMINTHS.—The class of flat worms.
POLAR BODIES.—The minute cellular bodies which become separated from the ovum during the maturation process.
POLYDACTYLISM.—The anomalous condition of having more than the normal number of digits.
PORIFERA.—Multicellular organisms of the sponge class.
PREFORMATION THEORY.—The doctrine that the fully formed organism is contained in miniature in the germ cell, and that development depends upon its unfolding and growth.
PRESBYOPHRENIA.—A type of senile deterioration marked by defective impressibility of memory.
PRIMATES.—Mammals of the highest type, including monkeys, apes and man.
PROPRIOCEPTIVE RECEPTORS.—Receptors for body stimuli in contrast with those of the visceral, and those for external stimuli.
PSEUDO-HALLUCINATION.—Sense falsification due to ideas of morbid intensity.
PSYCHIC EPILEPSY.—Epileptic psychoses, in which abnormal mental states may occur apparently in the place of convulsive seizures.
PSYCHOGENIC.—The term applied to mental states or symptoms that are of purely mental origin.
PSYCHOMOTOR RETARDATION.—Diminution of mental and motor activity commonly seen in states of mental depression.
PYRAMIDAL TRACTS.—The motor paths of the central nervous system arising in the neurons of the cortical motor area, which constitute the "pyramids" of the medulla oblongata.
PYROMANIA.—The morbid impulse to set fire to objects.

RECEPTOR.—A differentiated cell or structure for the reception of stimuli; a sensory organ.
RECESSIVE CHARACTER.—An inherited character which remains undeveloped when mated with a dominant character (Conklin).
REDUCTION DIVISION.—The mitotic division of the germ cell in which the number of chromosomes is reduced one-half.
REFLEX ACTS.—Responses to external stimuli brought about through the activity of a receptor-effector system, *viz.*, a sensory-motor system.
REMISSIONS.—Periods of abatement of mental symptoms.
REPRODUCTION (CELL).—The processes by which organisms multiply for the continuation of a species.
RESTING NUCLEUS.—The nucleus of a mature cell prepared for further subdivision.
RETENTIVENESS.—The capacity for storing the effects of stimulation.

SCHIZOPHRENIC PSYCHOSES.—Psychoses in which the fundamental symptom appears as a "splitting of the personality" (Bleuler).
SEA ANEMONE.—A form of cœlenterate possessing the diffuse type of nervous system.
SECRETIN.—A hormone believed to be capable of stimulating glandular cells to activity.
SEGREGATION.—The separation of contrasting parental characteristics in the offspring or zygotes of hybrids.
SENSITIVITY.—The capacity of an organism for receiving and responding to stimuli.
SEX-CHROMOSOME.—The "odd" or accessory chromosome regarded as a determiner of sex.
SEX-LINKED INHERITANCE.—The inheritance of characters the factors for which are associated with the factor for the determination of sex.
SIMPLE SENSATION.—A mental element; a mode of affection through the medium of the sense organs and the nervous system.
SIMPLEX CHARACTERS.—Characters that are determined by factors derived from one parent only.
SOMA.—The body of an organism as contrasted with the germ cells or visceral cells.
SOMÆSTHETIC AREA.—The primary motor and sensory area of the cerebral cortex.
SOMATIC CELLS.—Cells having no direct part in reproduction as contrasted with germinal cells.
SOMATIC DIVISION OF THE NERVOUS SYSTEM.—The portion of the nervous system corresponding with the sensori-motor cerebro-spinal nervous system in man.
SOMATOPSYCHIC DELUSION.—A morbid belief referred to a part or condition of the patient's body.
SPERMATOGENESIS.—The development of spermatozoa from the primary male sex-cells.
SPERMATOGONIA.—The primitive male sex-cells.
SPINDLE.—The fibrillar arrangement of the nuclear material during mitotic cell division.
SPONGIOBLASTS.—Cells of the neural tube differentiated for the development of neuroglia cells.
STATIC SENSE.—The sense of equilibrium.
STEREOGNOSIS.—The perceptive process by which the shape of objects may be recognized through the sense of touch.
STEREOTYPY.—A motility disorder characterized by fixed modes of speech and action seen in catatonic patients.
STIMULUS.—Any form of energy acting upon an organism which tends to arouse response.
STRIATUM.—The striate body (*corpus striatum*); the masses of gray matter consisting of two of the basal ganglia separated by a sheet of white matter (internal capsule), which are chiefly motor in function.
SUMMATION.—The inherent capacity of cells for the retention of the effects of stimuli.
SYNAPSIS.—The conjugation of maternal and paternal chromosomes previous to the maturation divisions.
SYNDACTYLISM.—The anomalous condition of having webbed fingers or toes; the failure of the separation of the digits.
SYNTHESIS.—The fusion of elementary mental experiences into compounds.

THALAMUS.—The large ganglionic masses in each hemisphere through which all afferent impulses, except those from the olfactory organs, pass on the way to the sensory cortex.
TREMATODE.—A non-segmented flatworm having a ganglionic type of nervous system.
TREPONEMA PALLIDUM.—The organism found in syphilitic lesions.
TROPISMS.—The reactions of organisms towards or away from the source of stimuli.
TURBELLARIA.—Ciliated flatworms.

UNCINATE GYRUS.—The cerebral convolution on the mesial aspect of the temporal lobe of the cerebral hemisphere, in which are located the areas for taste and smell.
UNIT CHARACTER.—A character which is inherited in entirety.

VEGETATIVE NERVOUS SYSTEM.—The part of the nervous system controlling the visceral functions.
VERBIGERATION.—The continued repetition of senseless spoken words or written characters as seen in catatonic patients.
VERTEBRATA.—The subdivision of the phylum chordata, including all animals with a vertebral column and tubular type of nervous system.

X-CHROMOSOME.—The accessory chromosome regarded as determining sex.

ZYGOTE.—The organism resulting from the union of the male and female sex-cells; offspring.

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