Brain in relation to mind / by J. Sanderson Christison.

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BRAIN IN RELATION TO MIND

CHRISTISON

Chicago Tribune.

OCT 2 1899

there are more Estabels in the world than great ladies and beautiful Princesses.

Dr. J. Sanderson Christison of Chicago has written and privately published a scientific treatise on "Brain in Relation to Mind." The author was formerly connected as a physician with New York City Asylums for the Insane, and has made a special study of "Crime and Criminals," of which a new edition has recently appeared. The present little volume is addressed to physicians and laymen, for the reason that "comparatively few physicians and fewer laymen have a satisfactory view of the relationship of brain to mind"—a statement that, probably, will meet with but little dissent.

As to the attitude of the author toward modern evolutionary science and the materialistic doctrine of mind, Dr. Christison holds that mind is not a mere cell product; that brain matter is not the source of the ideational process or in any way the basis of it, though he admits sensory impressions "doubtless in some way affect brain cells," but these effects he regards as nothing more than functional exaltations or depressions. He even says that "something of a mind must exist before a brain can be formed"—a statement that is supposed to prepare the reader for the following verdict on evolution:

> The materialistic theory of mind is a natural child of the current evolution idea, the greatest delusion of the nineteenth century. It is a product of patchwork and suggestion, and it not only creates more mysteries than it can seem to solve, but it is absolutely incompatible with law and order. We observe that laws of nature are immutable, or else chaos would result, and thus whatever is potential in plan must be specific in character— i. e.: unalterable in essential characteristics or affinity qualities. All entities are therefore immutable as laws, are not separable from them, but are identical with their properties. Nor can they lose their intrinsic properties unless it is also a law that laws are not necessarily immutable, which is a reductio ad absurdum.

To those who hold with Dr. Christison that evolution is a delusion his treatise will prove interesting. As to whether his premises are correct or not that is a matter for the scientists to decide. He has arrayed himself against the fundamental scientific idea of the century. The whole scientific world is against him. It will require more than this small treatise to prove that Christison is right and Darwin wrong.

Briefs of Balzac.

"The Personal Opinions of Honoré de

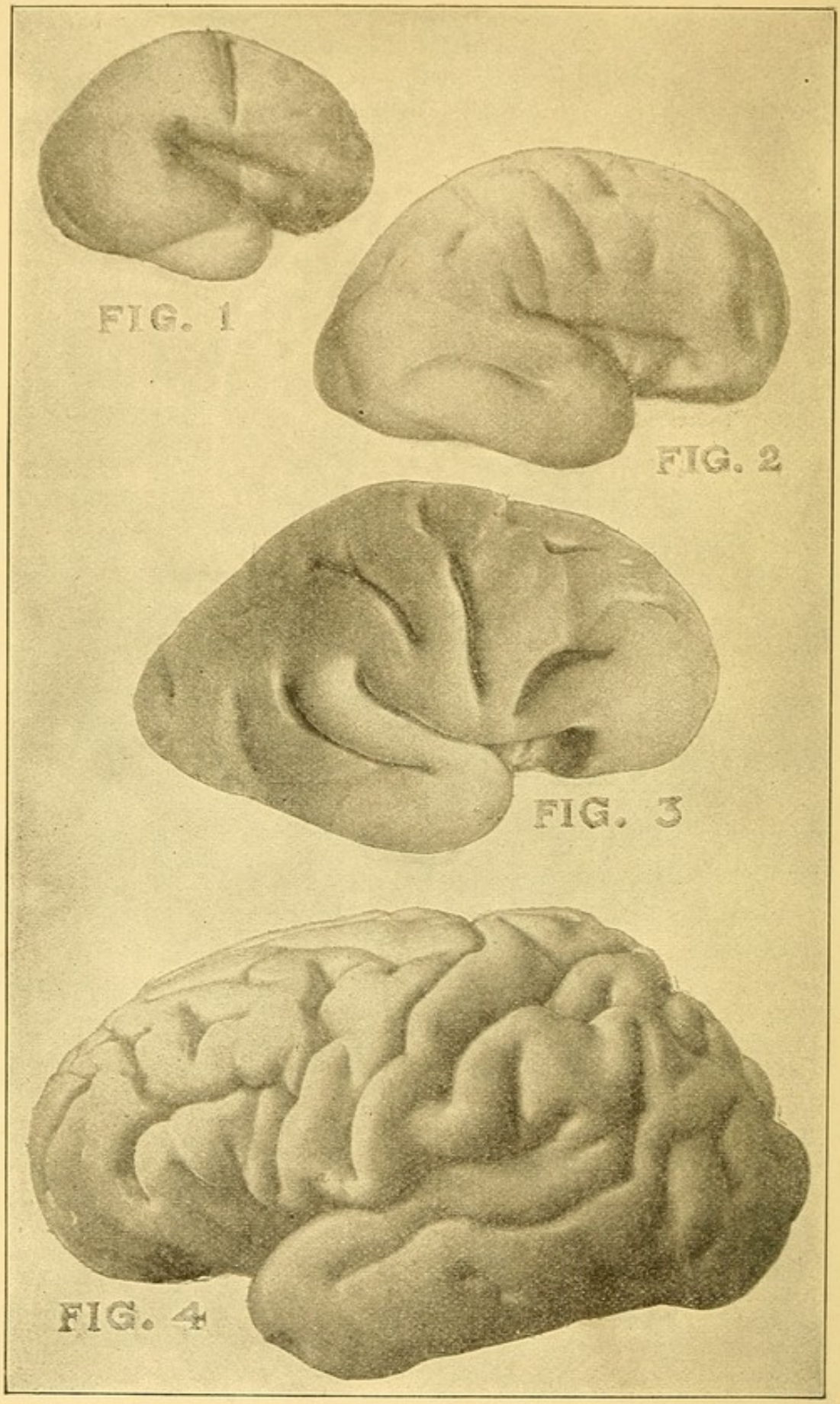


Plate showing stages in the development of the convolutions in the brain of the human embryo (after Professor D. J. Cunningham.)

Fig. 1, right side view, earlier part of the fifth month. Fig. 2, near the seventh month. Fig. 3, about the seventh month. Fig. 4, left side view between the eighth and ninth month; earlier stages shown on page 70.

Brain in Relation to Mind

— BY —

J. SANDERSON CHRISTISON, M.D.

Author of "Crime and Criminals," Etc. Formerly of the New York City Asylums for the Insane, Etc.

CHICAGO,

1899.

PREFACE.

This brochure is addressed to physicians and laymen. Comparatively few physicians and fewer laymen have a satisfactory view of the relationship of brain to mind, and thus a concise treatise upon the subject containing sufficient relevant facts to indicate the present status of our knowledge, must surely have a right to live, especially in view of the recent revival of the materialistic doctrine of mind.

The plan of the work, in the main, has been to cite facts rather than present arguments, and to establish these facts by the best of references. In the first chapter some general principles are applied to the claims of materialism, while the second and third chapters present a general outline of the development and functioning of the brain. Chapter IV presents data having reference to the theory that some part of the brain is the seat of the mind or is most subservient to thought activity.

Owing to the desirableness of brevity as an attractive feature to a large class of lay readers, some interesting deductions have been omitted, especially in regard to the data in Chapters V and VI. These I hope to point out in a psychological treatise.

The numbers in the text point to references given at the end of the book, where a short glossary for lay readers will also be found.

J. SANDERSON CHRISTISON,

Chicago, July, 1899. *100 State St.*

TABLE OF CONTENTS.

CHAPTER		PAGE
I.	General Consideration	7
II.	Brain Cells and Their Relations	19
III.	Theory of Sensory and Motor Centers	34
IV.	Theory of Mind Localization	47
V.	Brain Form in Relation to Mind	69
VI.	Brain Size in Relation to Mind	91
VII.	Normal Mind	109
VIII.	Supplement to Chapter iv.	143

CHAPTER I.

GENERAL CONSIDERATION.

The three principal doctrines of brain in relation to mind, are given by Dr. J. Hughlings Jackson as follows:

First. "That activities of the highest centers and mental states are one and the same thing, or different sides of the same thing. This doctrine has been destroyed."

Second. "That mind acts through the nervous system (through the highest centers first); here an immaterial agency is supposed to produce physical effects."

Third. "(*a*) States of consciousness (synonymously states of mind) are utterly different from nervous states of the highest centers; (*b*) The two things occur together, for every mental state there being a correlative nervous state; (*c*) Although the two things occur in parallelism, there is no inter-

ference the one with the other. Hence we do not say that psychical states are functions of the brain, but simply that they occur during the functioning of the brain."

Dr. Jackson holds the last theory, and observes that an essentially similar theory was held by Mill, Hamilton, Spencer, Clifford, Max Mueller, Huxley, Bain, DuBois Raymond, Laycock, Tyndall, Herman, etc. (1).

Notwithstanding the correctness of Dr. Jackson's statement that the materialistic doctrine of mind has been destroyed, it seems to be reviving with more assertiveness than ever, as the following recent utterances go to show.

Says Clodd: "If mind is an entity independent of brain, it would not only stand outside the ordinary conditions of development, but it would also maintain the equilibrium which a dose of narcotics or of alcohol, or which starvation and gorging alike rapidly upset" (2).

Dr. A. Morison in a lecture last year before the Royal College of Physicians, Edinburg, describes his view as follows: "The functions of the brain are receptive, retentive or connective and executive. Just as the functions of the stomach are the

reception, digestion and transmission of food, so the higher brain receives and inwardly digests impressions and transmutes them into action, voluntary, emotional, regulative and trophic" (3).

The *Medical Record*, New York, declares: "It is beyond controversy that the basis of the phenomenon which we call thought, depends upon the activities of certain cells or groups of cells more or less correlated." "Physiologically we judge a cell by what it does or by what it produces. For example if we take a liver cell, we know that one of its functions is to produce bile, and we know that alterations in the quality or quantity of the blood circulating in the liver cause changes in the physiological activities of such a hepatic cell. Thought is a manifestation of the combined and coordinated action of certain groups of cortical nerve cells, and the more complex the thought or the more varied its manifestations, the greater will be the number of cortical cells required for its development" (4).

Luys accounts for memory as follows: "These (the brain cells) are gifted with a sort of organic phosphorescence and are capable of vibrating and storing up external impressions." "They act simul-

taneously to produce the phenomena of memory, and separately give off reminiscences as illuminated bodies give off the luminous waves they have stored up in their substance" (5).

I propose to briefly discuss the subject under the terms of memory and thought, using memory in its ordinary sense.

It may be laid down as a general principle that the essential qualities in a cause must also enter into its results and exist in them in one way or another, so that a product must in some way reveal the nature of its origin by exhibiting something in common with it. It therefore follows that, as all matter is conditioned by time and space, it is inconceivable that anything which is not conditioned by these two universal essentials of matter can in any way have been derived *from* matter.

Thus, if mind was a product of brain cells in the same sense as bile is a product of liver cells, we would expect to recognize a parallelism or analogy either in the development of events or in the conditions of results, otherwise there could be no illustration, no analogy. But if we compare cell products with mental factors, we see on the one hand that all cell products are sooner or later dis-

charged and destroyed, and add nothing to the power of forming more, while on the other hand we see that the contents of mind are permanent acquisitions, everything being retained to add to the power for acquiring more. We know that remote and insignificant experiences may return to consciousness after an interval during which the brain may have changed matter many times, so great is its blood supply and so active is its metabolism.

It is thus evident that the tests of time and space (change and tangibility)—the two ever present and essential conditions of matter and energy—do not apply to the contents of mind, for while in the one case we have the transient and tangible, in the other case we have the permanent but intangible.

Indeed, if mind was a mere cell product, such a thing as memory could not exist, for every so-called "phosphorescent," deposit, "memory image" or sort of boxed impress would stand outside the physical economy if it did not share in the dissipation produced by the ceaseless chemic changes required by the organic law of supply and demand.

Again, to assume that reminiscences emanate

from cells in wave-like radiations to a coordinating point, would imply the existence of an elaborating entity beyond the brain. The same is true in supposing that sensory impressions upon the cells remained like dents upon a phonographic cylinder, creating the necessity for a special, controlling, outside agency to make them respond to the exigencies of life. Indeed, how could the brain, being a double organ, produce a unit, as mind is, by radiating subtle energies from its cell contents, unless there existed a unifying entity—an elaborating, concerting—and, by necessity, a metaphysical power? In fact, if brain matter was the source of the ideational process, or in any way the basis of it, the destruction of any portion would result in some form of mental blank enduring forever, for the coordinate cannot arise from the incoordinate any more than the living from the dead, or the existent from the non-existent.

While sensory impressions doubtless in some way affect brain cells, *i.e.*, create reactions, and thus produce some kind of result or modified state in the cells, we have no reason to assume that the results are anything more than functional exaltations or depressions, for the brain can have a

conditioning and sympathetic influence only as a *medium* of action, sensory and motor.

The theory that complexity of thought requires the activity of a corresponding number of brain cells needs the support of facts, while so far as we know (excepting microcephales) brain cells are both structurally and numerically alike in high and lowly peoples—the savage and the sage—the kindergarten and the senate. And how often do we find great minds with small brains and common minds with large brains? The fact of microcephalic idiocy is not a pertinent illustration here, as the mind in that state is congenitally fettered. But complexity of thought is so evidently dependent upon the nature, number and relating of ideas *directed to a purpose*, that it is not certain that brain cells enter into the problem at all, as chapter iv. strongly suggests. For all we know, sleep may be our time of greatest mental activity, as many difficult problems are solved unconsciously, and multitudes of daily cares are nightly adjusted.

Another obvious principle is overlooked by materialists. It is a biologic axiom that function precedes organization, for while we may also say that necessity develops function in much the same

sense, that we say it is the mother of invention, it is evident that the use of means to a given end implies the pre-existence of a specific potentiality, having a plan in the abstract, for only the pre-existing can be the cause of a necessity. Thus it follows that something of a mind must exist before a brain can be formed.

To a certain extent, mind and brain so evidently develop along parallel lines, or rather by reacting steps, that the state of the one conditions something of the action of the other, as master and servant,

That some thinkers cannot conceive of mind existing apart from brain, is simply due to their habit of thought, for it is nevertheless a fact that personalities stand apart from physical features and that we know them best when somatic conditions are associated the least. Do we not distinguish between the lovable personality and the repulsive form, while we find criminal characters with attractive features? While the association of personality with brain or body is simply a habit, to conceive of mind existing apart from a fitting environment is a very different thing.

The materialistic theory of mind is a natural child of the current evolution idea, the greatest

delusion of the 19th century. It is a product of patch work and suggestion, and it not only creates more mysteries than it can seem to solve, but it is absolutely incompatible with law and order. We observe that laws of nature are immutable, or else chaos would result, and thus whatever is potential in plan must be specific in character, *i. e.*, unalterable in essential characteristics or affinity qualities. All entities are therefore immutable as laws, are not separable from them, but are identical with their properties. Nor can they lose their intrinsic properties unless it is also a law that laws are not necessarily immutable, which is a *reductio ad absurdum*.

Thus development is the intrinsic law of life, which with the extrinsic complement (environment) gives extension and expansion along lines of affinity limited by the specific character of the entity.

The theory twin to evolution is atavism, which implies a reversion to an organic state level with a lower biologic type, and which the so-called "stygmata of degeneracy" are regarded as signs and symptoms. But such a view is contradicted by facts far more fundamental in character. Vir-

chow and others have shown that individuals with ape-like brains are not only destitute of the mental characteristics of the ape, but possess every characteristic of the human mind (see page 84). And when we find that individuals have filled the business and social functions of life in the ordinary way, who were either destitute of a *corpus callosum* (see page 65) or had but little more than half a brain (see page 62), it is evident that external features are not necessarily of fundamental significance.

While physical defects and deformities are mostly found where we mostly find mental and moral irregularities, it is not because the one group of facts are expressive of the other, but simply because psychic and somatic evils usually co-exist in prenatal environment, as they also do elsewhere. In post-natal or extended environment, the psychic evils may be either increased or reduced while the physical forms remain. Thus it is that in every-day life, mental and moral qualities are seen to have no regular relationship to anatomical features.

It has been observed that among feeble-minded children there are types which resemble foreign races, as the Malay, Mongolian, Negro and North

American Indian. But the same may be observed among the ordinary population in London or New York, or even in any large crowd. Indeed resemblances to such types are too frequently observable among our best citizens to suggest atavism in humbler people, even if we believed that races inferior in civilization were also biologically lower, which we know is not the case.

When we speak of disease as causing mental or moral obliquity, we simply mean to imply that without a morbid physiologic state the particular thoughts or acts would not have arisen under the given circumstances, while we recognize that every form of delinquency is traceable to a moral cause in its last analysis, either as an egotistic rebellion to first principles or a traduction by personal influences, operating directly or indirectly.

The remarkable results in character change obtained by home and foreign missions, present an array of "clinical" facts, so to speak, which demonstrate the power of ideational substitution over morbid habits and physiologic states, and also that the term incurable relates to means and skill rather than the nature of maladies.

One suggestion more. It is axiomatic that the

origin, plan and purpose of anything cannot be comprehended by an intelligence of a lower level than the character of its cause. The lesser does not comprehend the greater, nor is the co-ordinate the co-equal. Yet men demand to know, and some men even declare they do know, the origin and plan of creation. Such egotism carries in its presumptions the elements of its own destruction, by turning hope into fatalism, misconduct into misfortune, and the moral aspect of life into a stupid delusion.

CHAPTER II.

BRAIN CELLS AND THEIR RELATIONS.

The nervous matter of the body is arranged in ganglia (cell-groups) cords and plexuses (networks) forming two systems, viz: the cerebro-spinal and the sympathetic. The cerebro-spinal system has to do with the receptive and expressive functions of life — those most directly subservient to mind requirements, viz: the sensory organs and voluntary muscles, while the sympathetic system is in immediate charge of the functions performed by the organs of digestion, secretion, circulation, respiration, elimination and reproduction. But some nerves distributed to the organs connected with the sympathetic system come directly from the cerebro-spinal system; also the lungs, the heart and the upper and lower parts of the alimentary canal receive nerves directly from it, and those organs which are not directly connected with the

cerebro-spinal system receive fibers derived originally from it through their sympathetic plexuses. On the other hand, some of the nerves arising from the cerebro-spinal system within the brain, have a close affinity with fibers from the sympathetic system (Quain) and it seems impossible, even with the aid of the microscope, to distinguish between the sensory and the secretory-motor fibers within the glandular organs (1); while, according to Foster, in all organs in the normal state, except the skin and nervous system, stimulation fails to affect consciousness, but in an abnormal condition, consciousness is affected by a sense of pain (2). Thus it is evident that the division of the two great systems of nerves is not at all points distinct.

The brain not only comprises the central ganglia of the cerebro-spinal system, but also a portion of the sympathetic system, although most of the fibers of the sympathetic system connect with the brain as constituents of the roots of certain of the cerebro-spinal nerves and thus they have only an indirect connection with the brain. The cerebro-spinal system of nerves comprises a series of symmetrical pairs, twelve of which issue from separate apertures at the base of the skull and are known as cranial

nerves. They have to do with the special senses and the numerous muscles of the head, face, mouth, throat, etc. The pair next below these make their exit between the base of the skull and the atlas bone, while the remaining thirty pairs of nerves all issue below the successive segments of the spinal column.

The part of the brain which has been most studied is its gray-matter covering or cortex, which entirely surrounds its hemispheres except at their points of union. Owing to the peculiar formation of the brain into convolutions or gyri, which form more or less deep infolds or fissures, the deepest of which serve to divide the brain into lobes, only about one-third of the cortex appears externally. The thickness of the cortex varies at different locations and points, ranging from 1.5 to 4 mm. Toward the front of the brain, and especially at the summit of the pre-central convolution, in what is commonly known as the sensory-motor area, the cortex is not only the thickest, but its cells are the largest, while in the visual areas at the back of the brain the cortex is the thinnest it is also the densest (3).

While minute but very elastic blood-vessels and lymphatic canals exist in great abundance within

the cortex, its constituents of chief interest are the cells of various forms which are stationed in a more

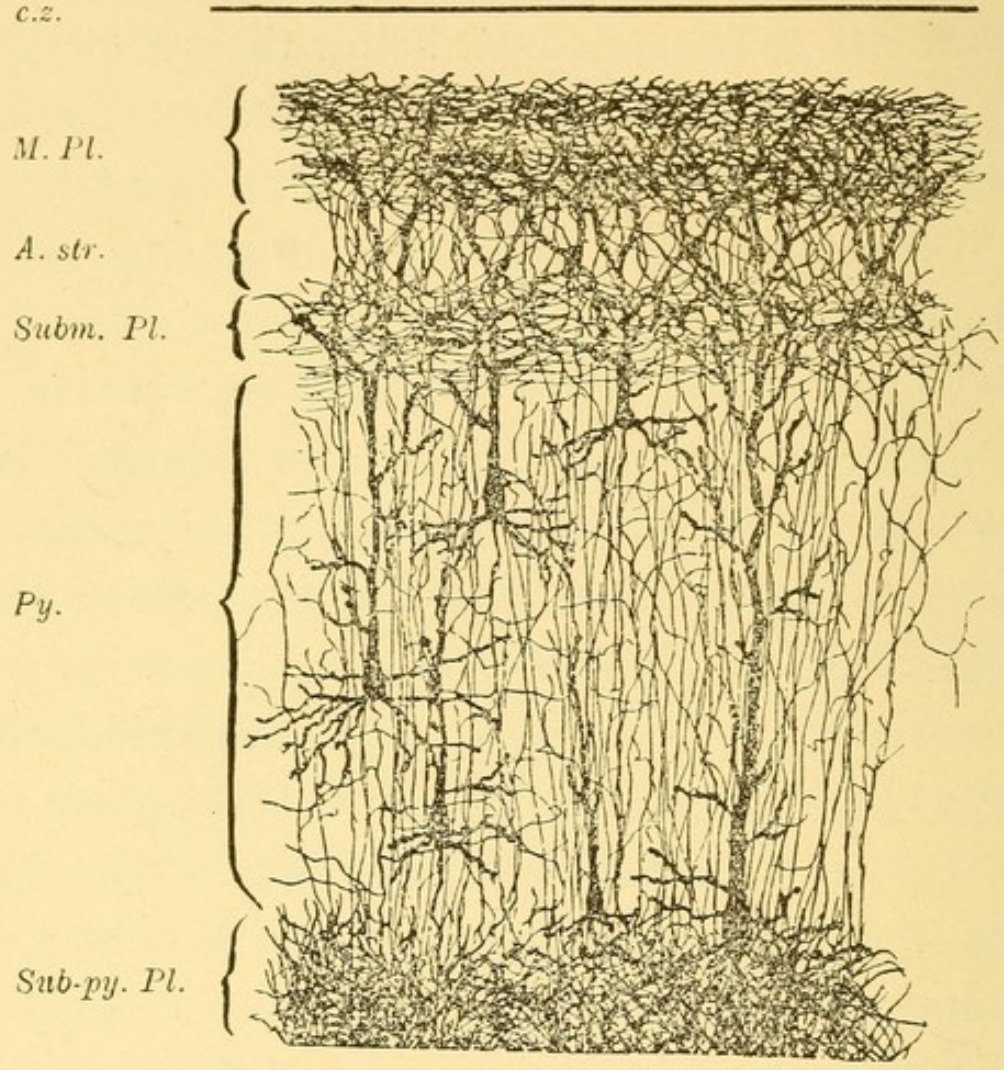


FIG. 1. (From Andriezen).—Microscopic view of a vertical section of the human cortex, showing the ambiguous and long pyramidal cells and the nervo-protoplasmic plexuses belonging to them. *c. z.* Clear zone. *M. Pl.* Molecular nervo-protoplasmic plexus. *A. str.* Stratum of ambiguous cells (three are shown). *Subm. Pl.* Sub-molecular plexus. *Py.* Deep stratum of long pyramidal cells (four are shown, and in the deeper part two "short pyramidal cells" are also shown). *Sub-py.* Sub-pyramidal plexus (of which the upper half is only shown).

or less orderly arrangement of layers, the number of which is variously estimated at from three to

eight, while five is the number usually imputed. While Golgi, Cajal, Goltz, Von Köelliker and most

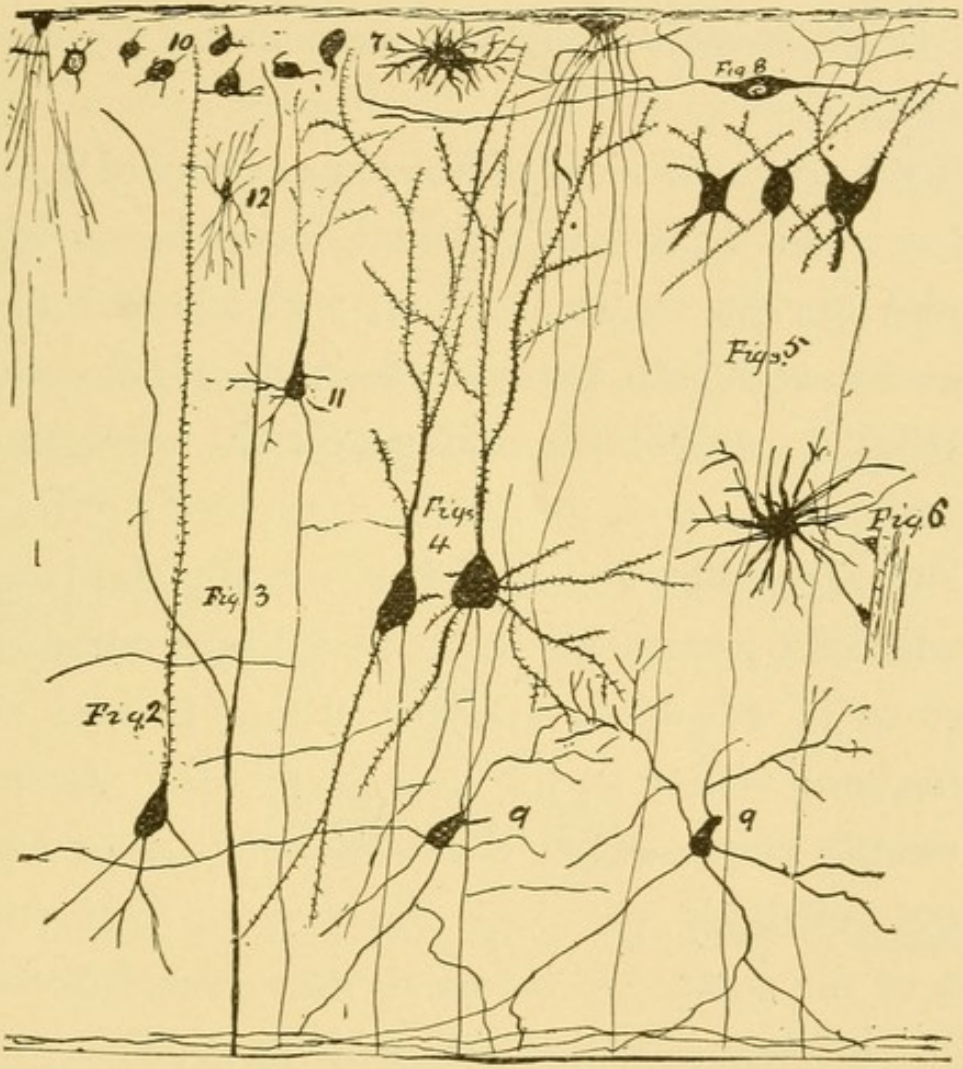


FIG. 2.—Showing the common forms of the cells in the cortex of the human brain. 1. Tangenital nerve-fibers at the surface of the cortex. 2. Fusiform nerve-cell. 3. Nerve-fiber from white matter (supposed to be sensory). 4. Pyramidal nerve-cells (motor). 5 Forms of motor cells. 6. Protoplasmic neurogliar cell attached to an artery. 7. Glia cell of first layer. 8. Spindle cell. 9. Polymorphic cell. 10. Granular cells. 11. Small pyramidal cell. 12. Spider cell. (After various observers)

other investigators agree that parts of the cortex having different functions show throughout essen-

tially the same structure, Flechsig asserts he has found a form of cell peculiar to one location, viz., the large spindle cell of Branca in the gyrus fornicatus.

A microscopic view of a cross-section of the cortex reveals what much resembles a forest of uprooted shrubs in winter bud, and associated with other forms of cells variously named, spindle, spider, neurogliar, molecular and granular, according to their forms.

The shrub-like cell, which is usually the largest, is called the pyramidal cell, owing to the commonest form of its cell-body or bulb, which is said to be sometimes visible to the naked eye (4). As many as twenty processes or dendrons may grow from a single cell-body, the chief one growing in the direction of the surface. Some of these dendrons have many branches, which all grow at acute angles to the main stem. The tiny bud-like processes upon these tree-like branches are supposed to be the points of contact and communication with other cells, and to generate or receive energy or impulses from surrounding matter.

From a point in the cell-body, usually opposite the main dendron, there projects at least one pro-

cess or *neuron* which also gives off branches, but fewer and at right angles to the main stem, while the main stem passes into the white substance of the brain and onward to a near-by or remote point within the brain or spinal cord. These neurons are the first processes which develop from the cell-bodies. But, while the cell-body is parent to both dendron and neuron, it eventually sustains no more structural relationship to them than that of propinquity, for these two offshoots join ends to form what appears to be a cylindric rod, containing as

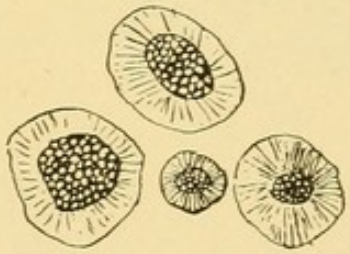


FIG 3.—Section of nerve-fibers showing the tubular appearance of the fibrils of the axis-cylinder (after Schäefer.)

many as fifty fibrils (19) which pass through the cell-body without interruption. Because of this structural development it is supposed that impulses do not originate in the cell-body, but in or at the buds of the dendrons. The cell-body, however, seems to remain the vital centre. The cell in its completeness—bulb, neurons and dendrons—appears to constitute an isolated anatomic unit, which associ-

ates but does not fuse with other cells or fibers, although its dendrons may extend to the surface of the cortex, and its neurons as far as the lumbar region of the spinal cord.

DEVELOPMENT OF THE CELL.

Within the first month of embryonic development, and while the brain resembles a distorted tube with here and there a bulge, the cortical cells have begun to appear as minute spheric objects,

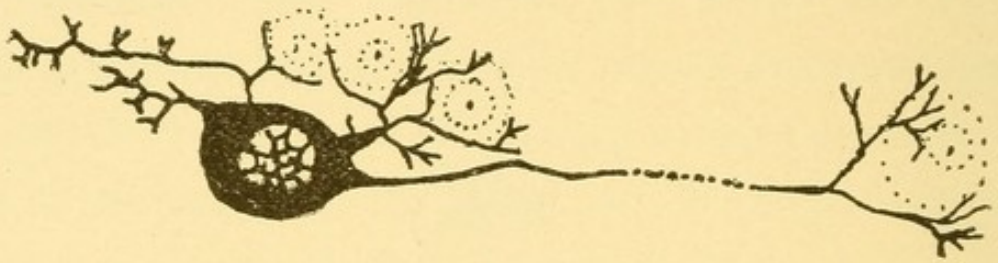


FIG. 4 —Diagram of sympathetic ganglion-cell (Retzius).

each of which develops a nucleus which contains one or two minuter bodies or nucleoli. These cells rapidly divide, one daughter cell remaining as the germinal cell, while the other migrates to become a fully fledged nerve-cell (5). This process goes on for about two months, after which the cells seemingly cease to multiply, but gradually increase in size from 1 to 500 times or more (6). They do not obtain their full growth until puberty or after, when the largest may measure at their base $\frac{1}{250}$ of an

inch in diameter and four or five times more in length, while its neurons and dendrons have made proportional gain in length and thickness. Neurons

FIG. 5.—Sensory and motor brain-cells—showing their interrelation as afferent and efferent neurons to the cortex, according to the idea of Cajal.

which at birth measure in diameter from 1.2 or 2 μ to 7 or 8 μ, become at maturity 10 to 15 μ respectively for the largest (7). The number of cells in 0.1 cubic mm. varies from five or six to ninety, but generally from ten to twenty, or more than three and a half billions in a brain, and constituting about one-tenth its total weight (5).

The neurons and dendrons gradually become enveloped in a fine medullary sheath which is regarded as both insulating and nutritive in its functions. Only a small proportion of the nerve-fibers of the cerebro-spinal system have no sheaths, while on the other hand very few of the fibers of the sympathetic system have any sheaths whatever. Some fibers of the sympathetic system do not functionate until they possess a sheath, and some do not have a sheath until late in middle life and most have none even then. But all sheathed fibers are exposed at their extremities.

Some cells seem never to develop beyond their first stage, while the lifetime of an individual cell may be co-extensive with the life of the person, for as Virchow observes, "all cells destined for the highest animal functions prove sterile, or at least very hypothetically capable of proliferation" (8). However, proliferation of brain-cells has lately been observed in some mature lower animals (9), while the "fungus" growths following injuries of the brain contain brain tissues (10), thus showing either a rapid proliferation or a rapid maturing of undeveloped cells, for it is a recognized histologic, as well as a pathologic law, that cells can only pro-

duce cells which are identic with them in constitution and function (8).

The brain-cells are very elastic and resistant to pressure, requiring considerable force to destroy their contour and break their processes (4). In their bulbs a small amount of yellow pigment is normally found, and which is supposed to represent bygone functional activity. This pigment is usually absent in idiots and imbeciles. The rest of the cell-body is composed of granular matter surrounding the nucleus. Brain-cells discharge impulses at the rate of ten per second (11), with a speed, according to Hammond, of 100 to 120 feet per second for motor nerves and about 24 feet per second for visceral nerves, while all nerves are capable of conducting impulses in either direction.

CHEMIC COMPOSITION.

From a chemic point of view, the ingredients of the brain are more numerous, more intricately constituted and more diversified than those of any other organ or system. It contains more than three hundred different chemic constituents, and those peculiar to the brain are endowed with great stability in a chemic sense and with great sensitiveness to reacting influences from without (12).

In gray matter there is 85 per cent. water and 1 per cent. ash, while in white matter there is only 70 per cent. water and 1.7 per cent. ash. The average specific gravity of gray matter is 1034 and for white matter 1041 (13). In the insane the average (thirty cases all kinds) is for white matter the same as normal, but for gray matter it is 1037, or a trifle heavier than in the sane (3).

VASCULAR SUPPLY OF THE CORTEX.

In its supply of blood-vessels the cortex is independent of the other parts of the brain, and it is said that it can maintain its functional activity even when three of its four arteries are obliterated. Autopsies upon cases of sudden death not infrequently disclose the fact that owing to obstructive organic disease of the heart, a greatly reduced circulation of blood has sufficed to maintain the requirements of the brain for ordinary purposes.

Unlike other arteries of the body the arteries of the brain rarely fuse together. It has been thought that they were devoid of nerve-fibers, but that has been disproved by Oberstiner, Morison (14) and others. It has also been observed that when the other arteries of the body are calcified by disease the arteries of the brain remain soft and yielding

(15). The vast number of small blood-vessels and capillaries within the brain not only afford it a liberal supply of nutriment, but serve as an elastic padding to the cells and fibers, which are supported in posi-

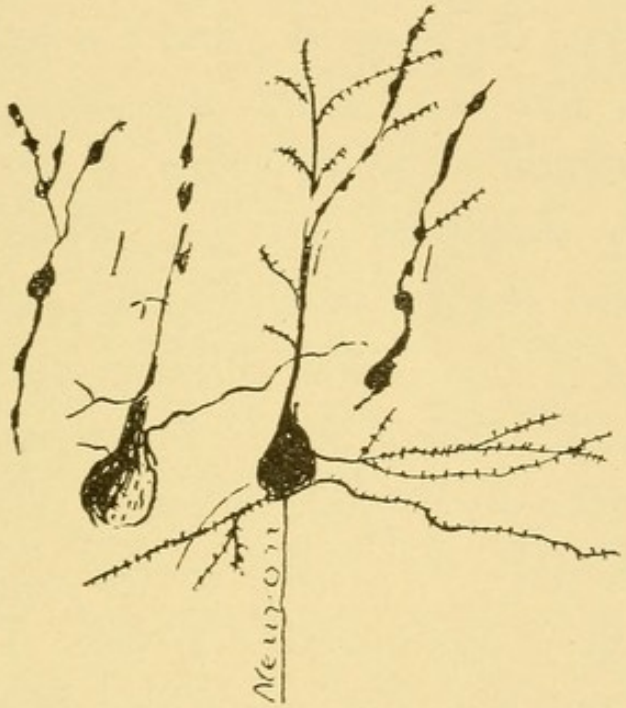


FIG. 6.—Alcoholic degeneration of the cortical nerve-cells—various stages.

tion by an abundance of fine connective tissue, which, with the blood-vessels, constitute about one-fourth of the entire brain mass (5).

GROWTH AND DECLINE OF THE BRAIN.

At birth the brain weighs about 12 per cent. of the whole body or an average of 340 gm. for males and 330 gm. for females. It is, therefore, nearly one-fourth its size at maturity, at which time it

weighs only about 2 per cent. of the whole body. During the first nine months after birth the brain gains about one-third its whole increase and by the eighth or ninth year it has attained nearly its full growth. (16) Dr. Robert Boyd found that the brains of boys between the ages of 4 and 7 weighed on an average 1214 gm., and about the same for girls; but boys between 7 and 14 years of age gave an average brain weight of 1410 gm., while girls between the same years gave an average brain weight of only 1265 gm. (17) These children were from the poor of London. According to Fuchs and Vulpius, the brain is not fully organized until 7 or 8 years of age, at which stage its growth makes a pause until puberty, when it again makes a rise. Donaldson has pointed out that the curve for brain weight ordinarily shows a rise until the age of 55 years, while in the case of eminent men it shows a rise until 65 years of age, when it begins to decline (18.) After birth the most active period of brain growth is during the first four years.

The babe at birth is physiologically but little more than a "spinal thing," as Virchow long since termed it when its brain structure was much less known than now. At this stage but little else than

the spinal cord and medulla contain perfected nerve-fibers, which gradually extend upward to meet those developing from the cortex. According to Flechsig, those from the bodily-sense area of the cortex appear first and are followed by the appearance of fibers for the sense of smell. A month or so later the fibers for vision organize, and by about the third month after birth the fibers for the sense of hearing and volitional acts begin to mature.

In adults the increase of the brain is due to the growth of the cortical cells, the embryonic cells, and the other related structures. In old age the cells become heavily pigmented, while they atrophy, and many of the fibers are substituted by connective tissue. In senile dementia the spider cells increase in number. According to Althus, deaths from nervous diseases (excluding infant eclampsia) are only 7 per cent., and a large proportion of these are primarily due to diseases of the blood-vessels. Thus it is evident that while in health it suffers the least of all organs from a general starvation, it also suffers the least from disease. Its reparative and adaptive powers are greatest before the cells and fibers are fully formed, when broken fibers may unite and new fibers develop.

CHAPTER III.

THEORY OF SENSORY AND MOTOR CENTERS.

From the cells of the cortex fibers are distributed in all directions. Some go but a short distance to another part of the cortex in the same hemisphere, while others extend farther on. Some cross over (through the corpus callosum) to the cortex of the opposite hemisphere, *e. g.*, the visual sphere of one side connecting with the auditory and other spheres of the opposite side, while other fibers pass into lower ganglia or onward to cross over to the opposite side below the medulla from whence they extend to points within the spinal cord, where they end in twiglets which clasp hands, so to speak (but do not unite), with other twiglets from nerve cells in the spinal cord. From these spinal cells other nerve-fibers arise which extend to the various organs of the body—the skin, muscles, glands, etc.

Only about one-third of the cortex of the brain

seems to be in direct relation with the nerve tracts which cover the excitations of the periphery of the body, the bodily-sense fibers as described by Flechsig, and those fibers which conduct the impulses to

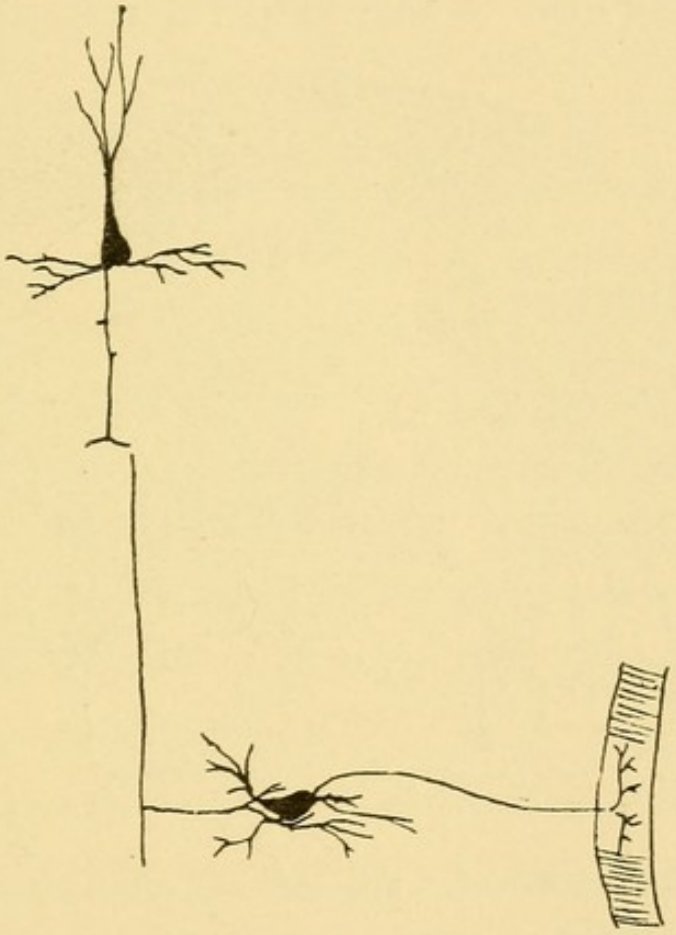


FIG. 1.—Motor nerve-cell connecting with muscle (after Edinger).

the muscles. The remaining two-thirds or so-called "silent areas" of the brain, areas which do not respond to experimental stimulations, or which produce no special motor or sensory disturbances when damaged, have therefore been supposed to be more especially subservient to intellectual operations.

The "association" bands of fibers vary in size and functional service, as well as in their order of development. Those connected with the sense of bodily needs (hunger, thirst, etc.) are, according to Flechsig, the first to complete organization within

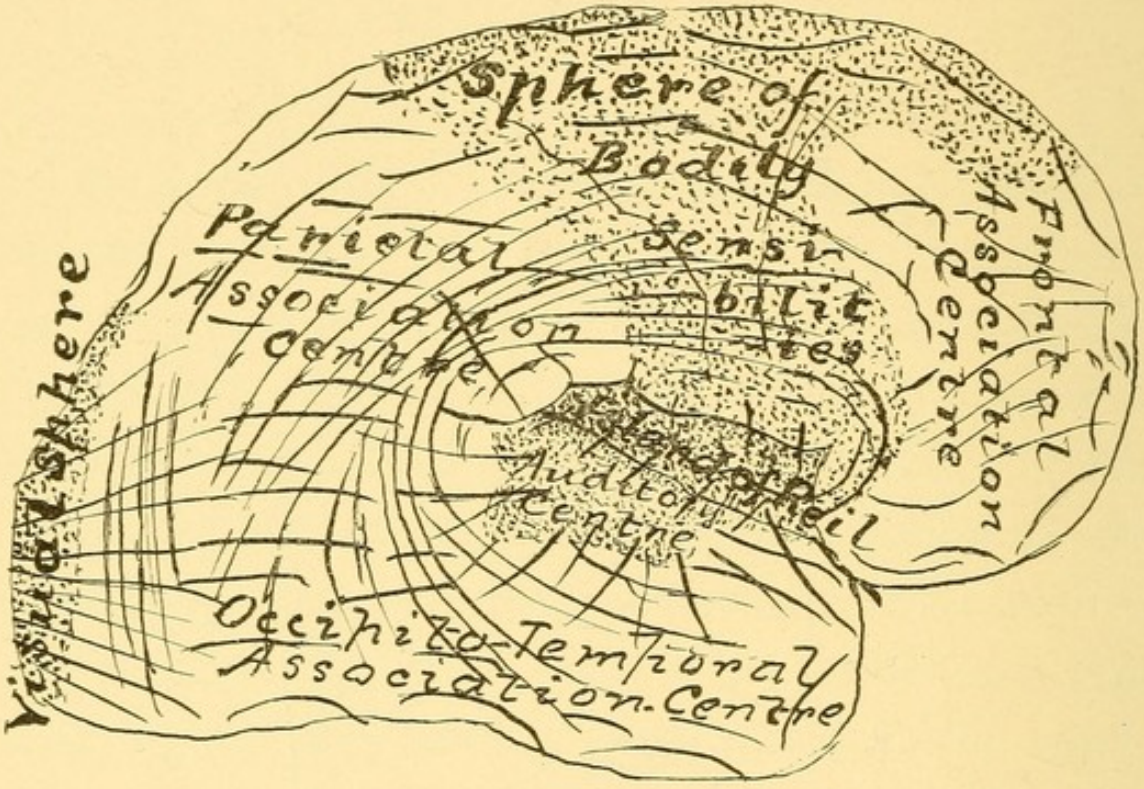


FIG. 2.—Indicating Flechsig's localization of brain centers.

the brain, while those connected with the special sense of smell develop later, or at the time of birth. By a month more the nerve-fibers for vision begin to mature, while it is another month before the organization of the fibers for the sense of hearing takes place. Last of all to organize are the so-called "silent areas" which even three months after birth

possess but few axis cylinders or sheathed fibers (2). But the development of fibers in the cortex, especially those originating in the first layer and extending parallel with it, is still in active process as late as the thirty-ninth year (3), while millions of undeveloped cells and fibers exist in old age (4).

According to Flechsig, the area of bodily sensation is much richer in association bands than are the other sensory organs. It is a sensory-motor area, and was formerly designated the "motor area" by experimentalists. It sends out numerous long bands of fibers into the middle of the great association centre, especially a large one to the outer surface and base of the temporal lobe. Flechsig says this band is distinguished from all others by its late development.

While the various areas of the brain are regarded as but highways of ingress and egress to the general cortex, every part of which has a wide range of association, directly or indirectly, it sometimes seems that damage to the brain more or less sudden affects mental action in a more or less special way according to its location and extent and whether or not the cells and the association fibers are both involved.

The peculiar affections of memory, or rather of recollection, which are classed as aphasias, sometimes seem to be due to localized affections of the sense centers or their connections, producing an uncompensated loss of an established and special physiologic correlate to a subtle mental process. Such localized affections, however, can only be

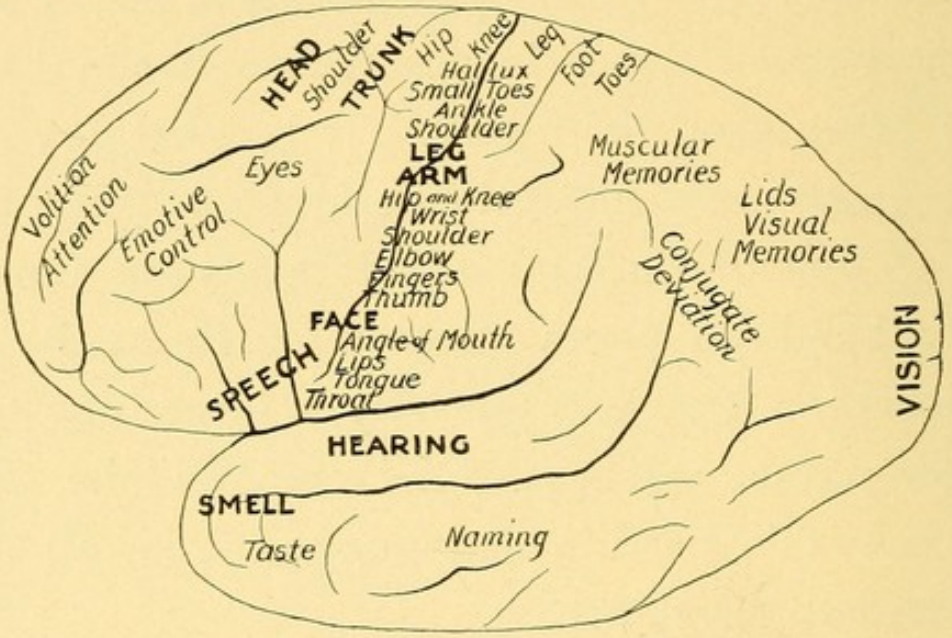


FIG. 3.—Showing the anatomical and hypothetical brain centers (8)

causative through a peculiar suggestive influence which in a negative or sub-conscious way inhibits ideational associations along special lines. For example, damage to the cells of a visual area may produce inability to recognize familiar objects by name, and thus cause a confusion of words and ideas, but otherwise the conduct of the subject may remain normal. But if the visual "association" fibers are affected, the result may be "mind-blind-

ness," or the inability to recognize familiar objects. If the cells of the auditory area are injured perceptive "word-deafness" may result, and if their "association" fibers are involved, "mind-deafness" or the inability to recognize the meaning of words heard, may result. In like manner damage to the speech center may produce inability to express words, while damage to the sense area for smell may pervert or abolish the faculty for smelling.

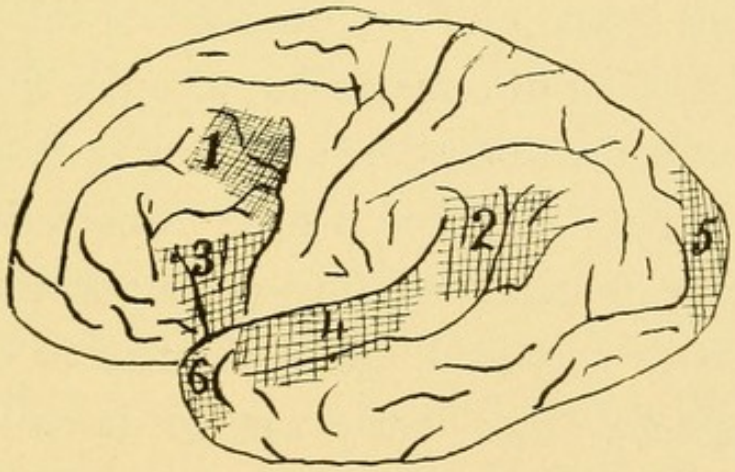


FIG. 4.—Showing areas of the brain which, when diseased, may cause (1) loss of power to write, (2) mind-blindness, (3) loss of speech, (4) mind-deafness, (5) loss of sight, (6) loss of smell.

But these phenomena seem to have much the same psycho-physiologic explanation as do hallucinations, viz., inhibition, or perversion along special memory lines or associating qualities of ideas with perversion or destruction of their correlated sense organs. Indeed, so subtle in their operation

are the laws of the mind that through perverting conditions certain groups of memory signs may be remembered, while others next them in time or space may be entirely forgotten for the time being. For example, a person may be able to speak and write numerals to some extent, while he has forgotten the alphabet, because numerals are associated by the stronger law (so to speak), as they represent the simplest kind of natural relationship in order and space—an evolutionary order or systematic proportion of one quality, whereas the alphabet is an artificial association of differing qualities.

A common and suggestive illustration of the perverting influence of the brain upon the less natural or later acquired habits of mind is observable in the proneness of many foreign-born Americans to revert to their native language when indulging in intoxicating drinks in English-speaking company, although for many years they may have been speaking English most of the time. Thus, as in the case of insanity proper, the most natural and earliest established habits persist the longest with the subject.

All mental defects whatever are correlative to abnormal or inefficient brain-cell reaction while, on the other hand, brain-cells can not in any way hold

memory images or sensory impressions of any kind, as every new impression must destroy the preceding, even if there was not a constant chemic change going on within them. Certain toxic drugs, especially those belonging to the order of Atropacæa, can produce aphasias and insanity.

Defective functioning of the brain-cells is expressed by sensory, motor and intellectual irregularities or inefficiencies. As abnormal conditions of the cells connected with the special senses must necessarily deliver wrong impressions at their centric ends in the brain, and thus discharge a wrong suggestive influence on the mind, the result is a misinterpretation or hallucination, but which may be corrected if the brain-cells in general are not too inefficient to preclude the requisite amount of attention (reasoning) to secure the correction. Illusions have the particular factor of expectancy, conscious or subconscious, in reference to a particular external object.

Delusions are due to a more or less general inefficiency of the brain-cells, reducing the vital energy below what is required for effective attention or the proper association of related ideas, while the character of the delusions, whether exalted or de-

pressed, will depend not only upon the character and environment of the subject but also upon those particular bodily organs (especially the glands)

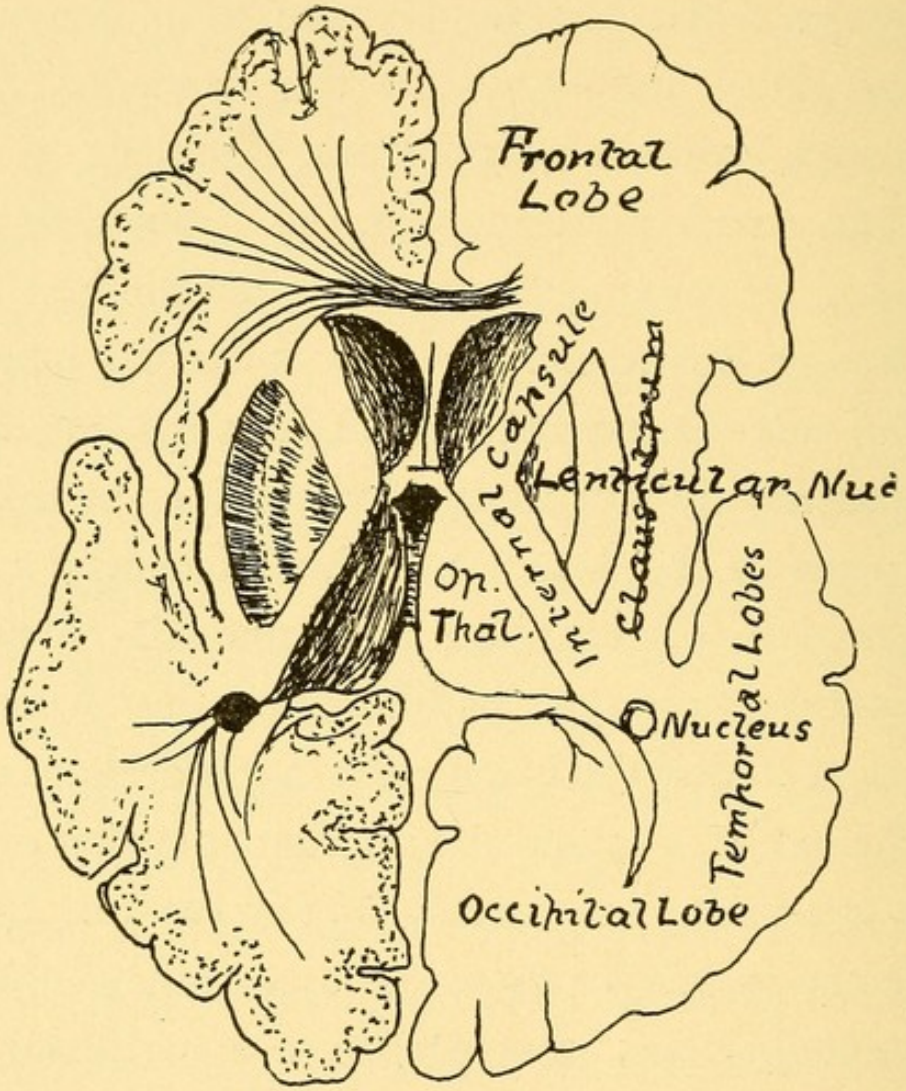


FIG. 5.—Horizontal section through the brain (after Edinger) showing the relation of some of the ganglia and the internal capsule through which the sensory-motor fibers from the cortex pass on their way downwards. On the outer side of the internal capsule is the corpus striatum, and on the inner side is the optic thalamus.

most perverted in function. All bodily organs have their special suggestive influence upon the mind

through their neural centers in the brain, for in this way they constantly influence our feelings so that by their normal and harmonious action the sense of well-being is experienced.

The great difference in the personalities of the two sexes, among normal individuals, must be due to differences in the functional character of their end-organs outside the brain, since the brain itself exhibits no sex characteristics whatever, either in its cells or architecture, a fact which is in harmony with the observation that common normal types of both sexes exhibit intellectual, moral and emotional qualities in very different proportions. Indeed, the cause and treatment of insanity are as a rule chiefly matters of glandular concern—of digestion, secretion and elimination. Idiopathic insanity or toxic insanities have no other pathology distinctive except in their final stages.

The brain requires regular sleep and food, but especially sleep. Dogs, which can live for twenty days without food, can not live more than five days without sleep (4). Man's limit of endurance without sleep is estimated at ten days. Some persons, especially seamen, soldiers and nurses, can sleep for a few minutes at a time and awaken at any

irregular hour desired. Before a great event with great anxiety, sleep comes, and it has been known to be so intense that a foot has been burnt to a cinder without realization of the fact until afterward (5). Sleep is thought to be due to a retraction of the dendron buds, thus breaking contact, and so interrupting or enfeebling the circuits of vitality between motor and sensory cells. That such an action is caused by an overloading of waste matter resulting from fatigue is quite unlikely, for in sound, normal sleep the circulation is greatly reduced in volume and force, indicating a corresponding reduction of metabolism and general functional activity. Normal sleep would rather seem to be due simply to the more or less exhaustion of the cells having an inherent demand for the restoration of their reacting power. The brain-cells can not be regarded as reservoirs of vital energy, but their power to react must correspond with their energizing efficiency, dependent upon nutrition as occasions demand, the demand being constant but fluctuating.

BASAL GANGLIA.

As yet but little is known of the corpus striatum, the optic thalamus and the corpus quadrigeminum. Lesions of the corpus striatum produce paralysis of

the opposite side of the body without mental symptoms; lesions of the optic thalamus produce loss or

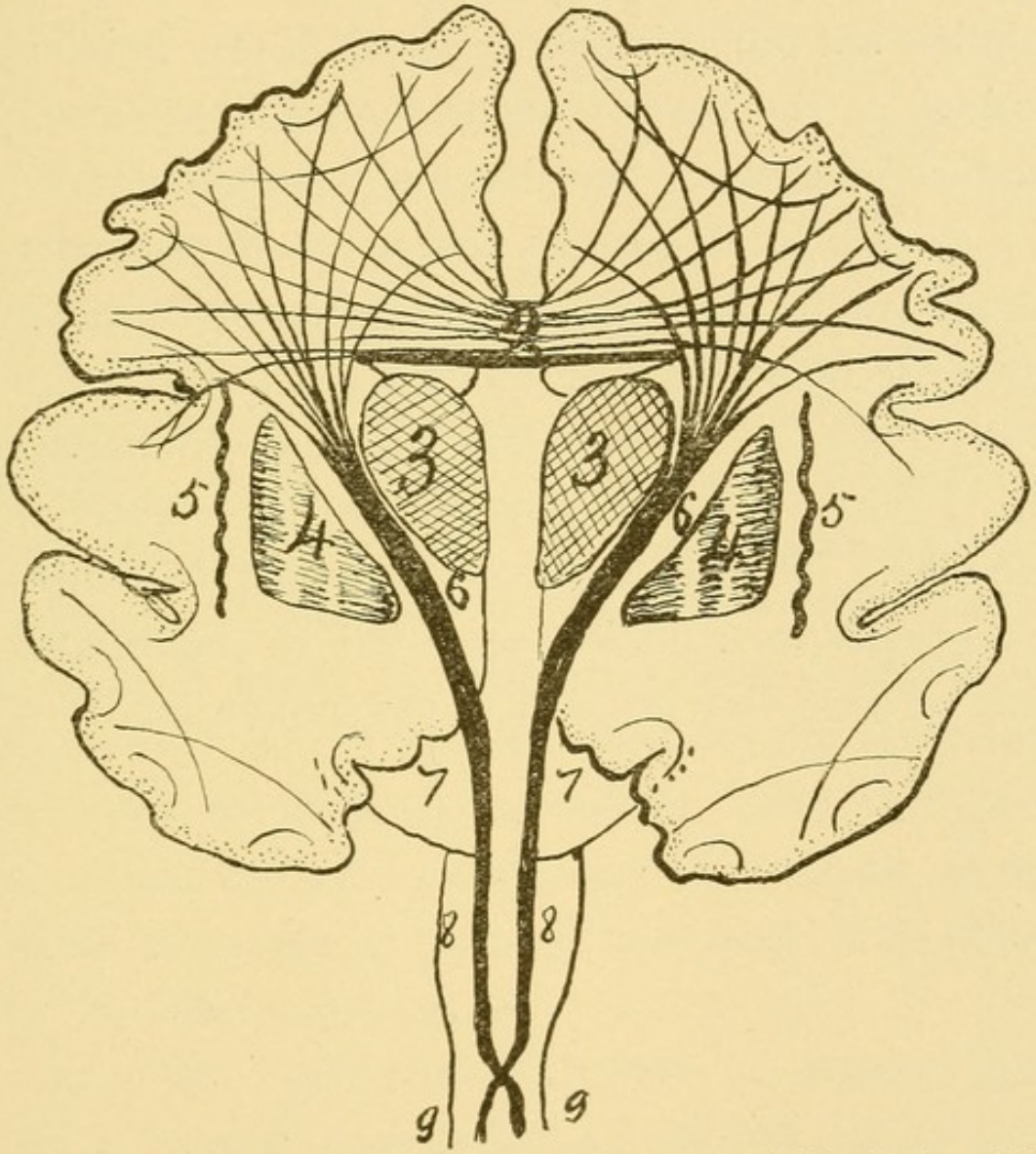


FIG 6.—Diagram illustrating the general plan of distribution of the nerve-fibers of the brain to the spinal cord and between the hemispheres and parts thereof; (2) corpus callosum; (3) optic thalamus; (4) corpus striatum; (5) claustrum; (6) sensory-motor fibers passing through the internal capsule from the cortex of the brain to the spinal cord; (7) pons; (8) medulla; (9) spinal cord.

impaired sensation of the opposite side of the body (6). Monokow believes every part of it is con-

nected with some part of the cortex (7), and according to the same authority it contains numerous cell bundles not found in the brains of lower animals. Lesions of the corpus quadrigeminum commonly produce blindness. Sterling and Landois regard it as a co-ordinating center. The cerebellum appears as functionally homogeneous. Lesions of it produce defects of muscular movement, while sensation remains intact, and instinct and intellect are unaffected. Each half controls mainly the muscles of its own side. The pons and medulla contain numerous gray-matter bodies regarded as internodes, some of which are peculiar to the human brain.

CHAPTER IV.

THEORY OF MIND LOCALIZATION.

The region of the brain most subservient to intellectual development is yet a matter of speculation, although the frontal lobes have been regarded by many as being in some way the psychic center. Disease of these lobes has been charged with causing intellectual perversions, character debasements and even delusions of grandeur. But that such conditions are neither peculiar to diseases of the frontal lobes nor necessarily connected with them, can be clearly shown.

Dr. E. W. Taylor reports a man, 36 years of age, with extensive destruction of the left frontal lobe of the brain, and yet, says Dr. Taylor: "When I last saw him the whole impression was that of a clear-headed vigorous man of exceptional intellect, but neurasthenic. A few days before his death he was filling a responsible position, and making

decisions of importance with accuracy and judgment." (1) The celebrated case of Gage need not

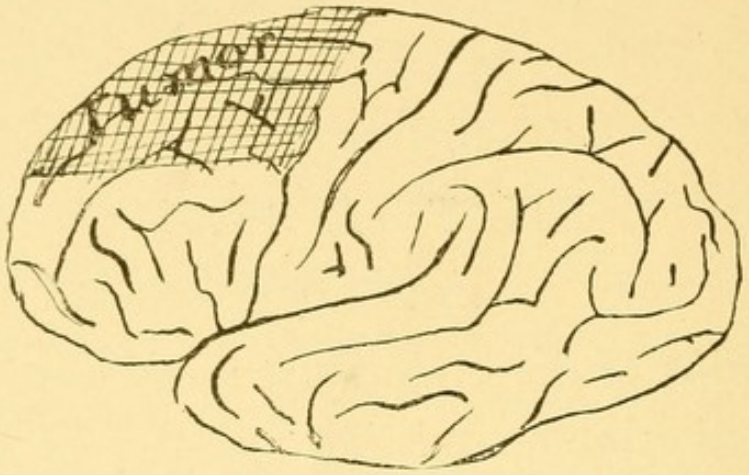


FIG. 1.—Illustrating Dr. Taylor's case of diseased frontal lobes of the brain with complete mental integrity. Shaded area indicates the location and extent as seen from the outside. Disease extended through the hemisphere and down to the corpus callosum.

be overlooked, in which a crow-bar was driven into his left cheek and passed out through the crown of his forehead while engaged at blasting. He immediately climbed into a wagon and rode home, where the doctor found him sitting upright in a chair, and apparently in full possession of his mental faculties. He afterwards lived twelve years, earning his living as a coachman and barnhand (2).

In this connection one of Bianchi's later experiments on monkeys will be of interest:

An adult domesticated female cynocephalus, whose habits, dispositions and peculiarities had

been carefelly noted for a long time, was deprived of her pre-frontal lobes as indicated in Fig. 3. Two months and more after this the mental change in her is described in the main as follows:

"Her physiognomy has become stupid and less

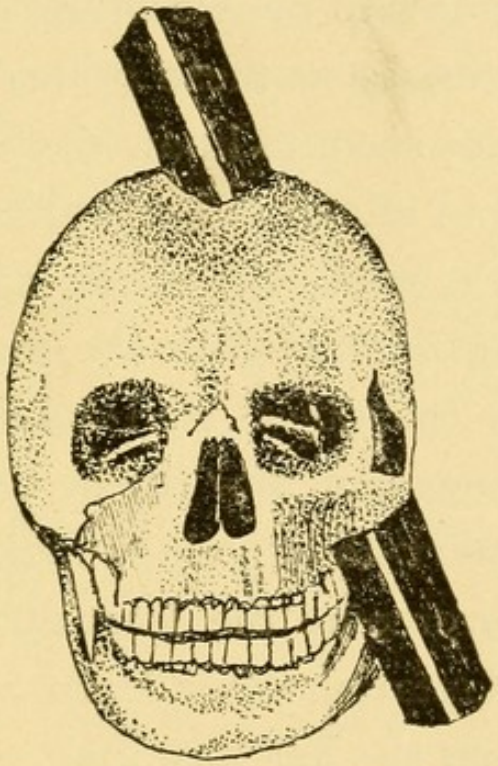


FIG. 2.—Illustrating the Gage case. (After Biglow.)

mobile; expression of eyes uncertain and cruel and devoid of any flashes of intelligence, curiosity, or sociability. She shows terror even by shrieks and gnashing of teeth, when threatened and hurt, but never reacts aggressively. She is in a state of unrest. When placed in a large closed room she walks aimlessly around, and always in the same

direction, without stopping near any object or person. Any action done with apparent purpose remains incomplete, unfinished; if she runs towards a door she stops near it, goes back, runs to the door again, and so on several times. She shows no affection or gratefulness to people whom she previously loaded with caresses as these animals are wont to do; she does not seem to know them, though they are ever ready to attend to her wants. Whenever approached for a caress she shows fear. When the attendant brings food or fruit she comes near and violently seizes the object with avidity. None of her former friends can now caress her any longer. She is unsociable with the other monkeys; does not play; cannot overcome the least difficulties in her way by new adaptations, nor learn anything new, nor recover what she has forgotten. She picks up and takes to her mouth whatever she comes across. She is, however, somewhat cleaner. The sexual instinct seems to be present, but the periods are less regular and abundant. She occasionally manifests impulses of cruelty quite foreign to her kind. One day while she was menstruating another female cynocephalus came near her. She at once manifested her desire; but finding the other unable to

satisfy it, she attacked her companion so furiously that she would have killed her if the keeper, armed with a stick, had not at once interfered. Later her movements became stereotyped. She walks about, sits, looks for parasites all over the body, and remains indifferent to everything except the sight of her food, and no longer expresses desires peculiar

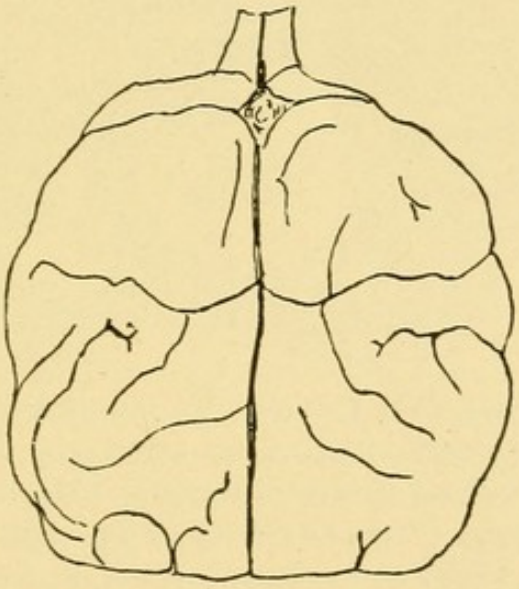


FIG. 3 —The brain of Prof Bianchi's monkey, after ablation of its pre-frontal convolutions. Operation made in front of the roots of the frontal convolutions, nearly corresponding to the pre-frontal sulcus.

to the time of menstruation. She has no sensory defects, and discrimination somewhat improves" (3).

The case reported by Drs. Starr and Van Gieson, (4) and one reported by myself (5), had each extensive destruction of both pre-frontal lobes, and yet neither of the subjects exhibited any mental aber-

ration aside from slow ideation, as manifested by slow replies to questions, and a consequent indifference, more or less, to some things of natural interest. Both were women alike in ages.

In the normal brained monkey deprived of both pre-frontal lobes (the same as those occupied by

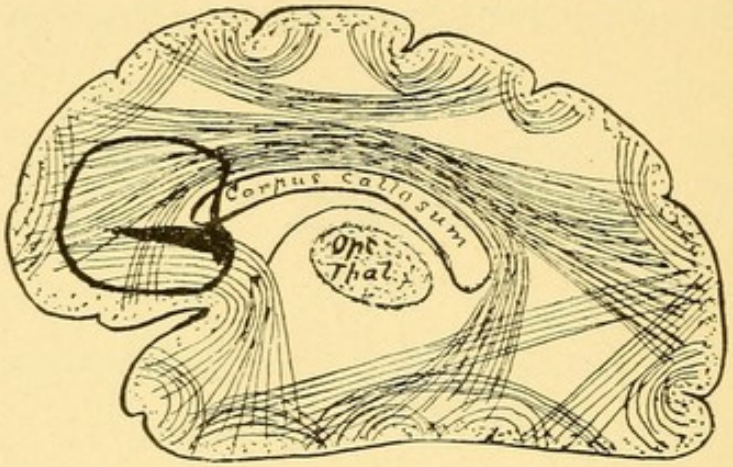


FIG. 4. Illustrating case reported by the author, of a double-sided disease of the pre-frontal lobes of the brain with mental integrity (5). Diagram of a longitudinal section of the left cerebral hemisphere, showing the antero-posterior extent of the tumor and some of the association fibers involved, as indicated by Starr. Horizontal black line below the front knee of the corpus callosum indicates the largest hemorrhagic area. It is on the left side.

tumors in the two women referred to), we have at least two factors contributing to its mental perversion which did not exist in the women, viz., (a) shock from a sudden loss of a great amount of energizing brain substance, and (b) a sense of loss of balance in the head from mass disproportion. In the women mass proportion remained just about the same while

the functional disturbance in the brain from invasion by the tumors was produced gradually. In the women there was also, presumably, a pre-existing brain inefficiency which made the development of

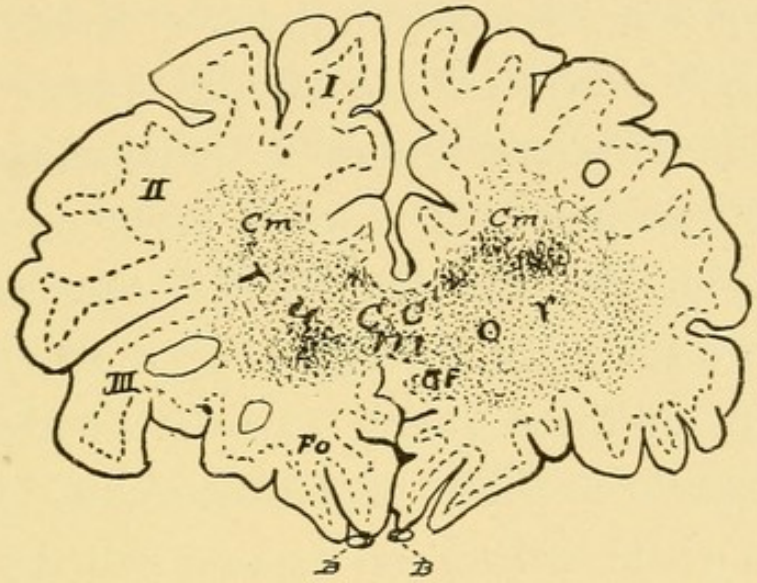


FIG. 5. Illustrating the same case as Figure 4. Front view, cross-section vertically through a point one inch in front of the mouth of the fissure of Sylvius. The tumor area extends about 1 inch behind the section and to the borders of the lateral ventricles. It occupies almost the whole of the white matter of the frontal lobes lying in front of the section. The darker areas are soft, dark-blue on reddish-brown and rotten tissue with hemorrhagic marks. *I, II, III.* Frontal convolutions. *BB.* Olfactory bulbs. *CC.* Corpus callosum. *GF.* Gyrus fornicatus. *CM.* Calloso-marginal fissure. *FO.* Olfactory fissure.

the tumors possible. We see, however, that as the monkey gradually loses the peculiar effect of shock and sense of mass disproportion, she more and more approaches the mental condition of the women who by disease had gradually and almost entirely lost the functional power of the lobes of

the brain. They all three practically exhibit nothing more than a loss of energizing power, or neurasthenia.

A case of negative evidence is reported by Dr. W. G. Spiller, of a girl, 13 years of age, with a considerable portion of the middle area of the left cerebral hemisphere rendered functionless by induration, but her frontal lobes were normal and well developed. Yet Dr. Spiller observes "she had only attained at the age of 13 the mental development of three years" (6). It is also worth noting that those tribes of Indians found in different parts of the world and known as "flat-heads" from their practice of severely compressing the forehead in infancy, are reported by all observers as usually being mentally superior to neighboring tribes who do not practice this deformity (7). Many men of great intellectual ability, *e. g.*, Sir Isaac Newton and Charles Darwin, had either low or receding foreheads.

Of late the trend of opinion favors the posterior lobes of the brain as being those chiefly involved with the higher mental processes. This view is based upon the following claims: *First:* As Gratiolet had pointed out, the posterior lobes are of later

development in the individual man, and thus it is inferred they are the least needed for the purely animal functions. (In apes, however, they are the first to develop.) *Second:* They are proportionately more developed in man than in the lower animals, and they only exist in the higher vertebrates. *Third:* In intellectually lower races the posterior lobes have been observed to be proportionately smaller; in some of the bushmen they fail to cover the cerebellum. *Fourth:* In some of the lowest mental grades within the lines of civilization, the posterior lobes are the smallest, especially so among idiots.

From an examination of 4,000 heads, of which 1944 were insane, and 183 were sane, Dr. Crochley Clapham found the average percentage by measurement of the frontal segment of the head (ear to ear) to the whole circumference, to be as follows: sane, 52.15; insane, 52.27; idiots, 52.30 (8). Professor Fowler and Dr. Garson are said to have found the same disproportion in the measurement of the skulls of the lower races. Dr. Clapham gives the average proportion by weight of the frontal lobe as follows: Idiots, 37.16; imbeciles, 37.11; all insane, 35.99 (8). These observations are certainly sug-

gestive, and yet it appears that in some monkeys the posterior lobes of the brain extend backward over the cerebellum farther than they do in man (9).

The great similarity in structure and contents of all parts of the cerebral cortex together with its intricate association systems of fibers, indicates that all parts must at least have one function in common, viz., that of contributing to the general supply of vital or nerve energy, while at the same time every area may be more or less specialized in a co-operative arrangement. Goltz and Flourens find reason to believe that the brain is capable of functional substitution, and also that only a small part of it, when intact, is required for mental integrity. Goltz found that in dogs the removal of their parietal lobes produced the same consecutive disturbances as does the removal of the frontal lobes (10). This observation is in harmony with the fact that a very large proportion of cases operated on for brain tumors had no tumors or lesions at the areas indicated by the symptoms presented, while some had no brain lesions whatever as disclosed by post-mortem examinations (11).

Beevor, in a recent symposium in *Brain*, sums up the evidence regarding tumors as follows: "Tu-

mors may occur without giving rise to the symptoms which would be expected, and tumors may give rise to symptoms which are associated with other parts of the brain, and tumors may occur without giving any symptoms at all, although situated in parts of the brain whose functions are considered to be known" (12).

Goltz has even found that removal of both cerebral hemispheres, accomplished by stages, does not abolish mental action (13). From a dog he removed both hemispheres, and yet it not only lived until killed, eighteen months afterwards, but exhibited defects only in the manifestations of intelligence, memory, reflection, and understanding. At first, it was necessary to feed it by placing the food directly into its throat, but later it learned to eat and drink by simply bringing its nose in contact with the food. Taste to some extent seemed to remain, for after a little chewing of food mixed with quinine, it would reject it. It showed signs of hunger and thirst by restlessness after prolonged intervals of privation, and then eagerly eating the food when given it. It would close its eyes when a bright light shone upon them, but Goltz was not certain that any of its movements were guided by

visual impressions. It slept naturally, and seemed to dream and could be awakened by loud noises and by handling. Strong, painful stimulations of the skin caused it to bark or growl, and even to snap and turn in the direction of the irritant, although it did not distinctly bite. It was able to maintain its equilibrium when one foot was placed upon a falling door, and it could move around on three legs. It could stand, walk, and run, but it exhibited no pleasure when caressed, nor any fear of threats. From such and other evidence Goltz, Golgi, Flourens and others deny that there are any definite motor or sensory areas in the brain.

While such experiments cannot be performed on human beings, disease and accident in a measure supply the want, the following illustrations being forcibly pertinent:

Case I.—Dr. E. W. Taylor reports (14) a two year old child with complete absence of both cerebral hemispheres, though the cerebellum was well formed and of normal size. He remarks that the child had "marked mental defects," which leaves the inference that its mental manifestations were human, though imperfect.

Case II.—Dr. Charles Phelps reports a man who

died at the age of 25 years with a large abscess in the middle area of the left cerebral hemisphere, while a large proportion of both hemispheres was either softened or invaded with punctate hemorrhages. Yet Dr. Phelps reports that this man "had absolute integrity of all his mental faculties and special senses without either having aberration or decadence, and was cheerful and slept well" (15).

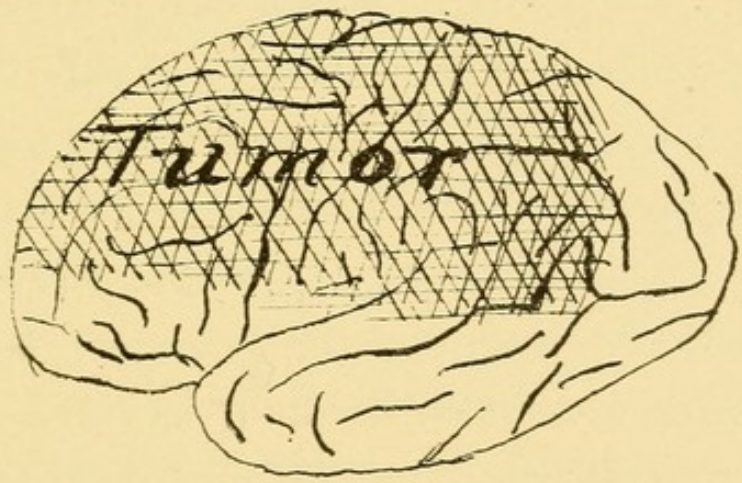


FIG. 6.—Illustrating Drs. Putnam and Richardson's case of complete mental integrity with an enormous tumor occupying the left cerebral hemisphere as indicated by the shaded area.

CASE III.—Drs. J. J. Putnam and M. H. Richardson report a business-man, 30 years of age, whose entire left cerebral hemisphere (except the occipital lobe and the lower portions of the frontal and temporal lobes) was occupied by a diseased growth, "which everywhere compressed the adjoining brain tissues and to a great extent destroyed them," and

yet in this man "no notable mental changes were observable." "His mind was clear and he read and understood with pleasure, and enjoyed the society of his family and friends," and although "he dragged his right leg he walked well, going to church and back half a mile off, and he drove his horse to town eight miles away, four days before his death" (16).

CASE IV.—Dr. Pierce Bailey reports a carpenter who died at the age of 57 years, whose right cerebral cortex was bereft of its cellular elements, and most of those that could be identified were greatly reduced in size, the large pyramidal cells being almost entirely gone, and the lumen of the cortical vessels being almost obliterated. A large cyst containing a straw-colored fluid occupied the frontal lobes of the same side. He died from pneumonia; yet "up to the last his speech was perfectly normal, reading was not interfered with, and memory was unaffected. He was courteous and intelligent and patient; he was cheerful and attentive, and his power of attention was very good. He read the papers constantly, liked to talk politics, and was interested in the affairs of the hospital. He was singularly free from periods of depression, of emo-

tional excitement, of irritability, of apathy, or of any other mental manifestation so common in gross brain diseases. He was cleanly, and in the three years of daily observation upon him there was nothing whatever at any time to indicate that his character or mental capacity was in the slightest affected" (17).

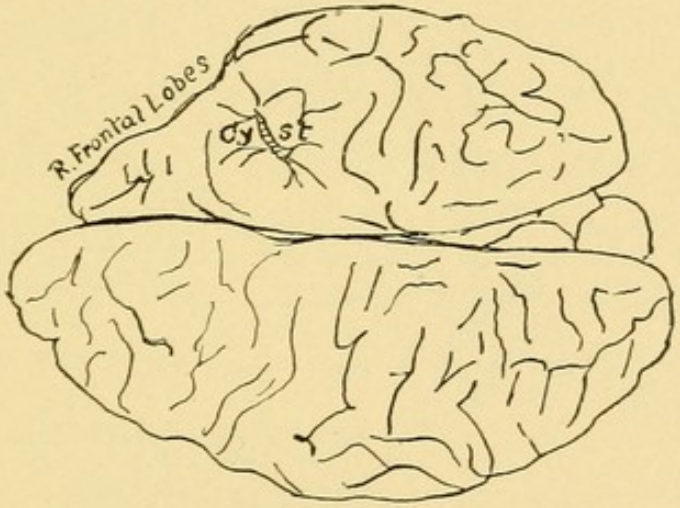


FIG. 7.—Illustrating Dr. Bailey's case of complete mental integrity with destruction of the right cerebral hemisphere and a large cyst in the frontal lobes.

CASE V.—Dr. W. B. Haddon reports a man, 21 years of age, with an enormous tumor occupying the left cerebral hemisphere, and severely compressing adjacent structures. Yet, although he occasionally had an epileptic fit and stammered slightly from childhood, he had no paralysis. He was somewhat opinionated, but evinced no moral perversion. At the time of his death (in a fit) he was

a clerk in the Steward's office of St. Thomas' Hospital, London, and a few days later he would have entered the government examination for a second grade certificate in perspective and drawing, branches in which he was pronounced by experts to be exceptionally proficient (18).

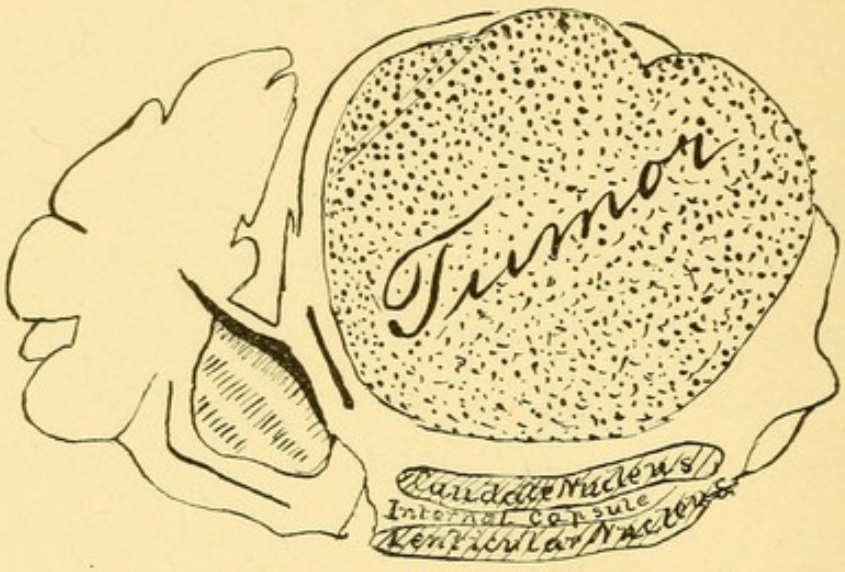


FIG. 8.—Illustrating Dr. Haddon's case of an expert draughtsman with complete mental integrity up to his death, yet possessed of an enormous tumor occupying the left cerebral hemisphere and compressing all adjacent organs. Front view, cross-section of his brain.

CASE VI.—Andral reports a man who died at the age of 28 years with the whole of his right cerebral hemisphere so completely atrophied that its covering membrane (pia mater) formed a cyst in which there was not a trace of brain tissue. The floor of the cyst was formed by the optic thalamus, the corpus striatum, and the parts on a level with these

two bodies. Yet, says Andral, this man "had received a good education, had a good memory, and exhibited as much intelligence as most men" (19).

CASE VII.—Drs. E. S. Boland and W. T. Whitney report a man, aged 46 years, who had a tumor occupying the entire breadth of the posterior part of the occipital lobe; yet his vision was not affected, as would be expected, though he at last became totally blind. He lost his sense of smell without the brain center for smell being affected, and was totally paralyzed on the left side without a "motor" center being affected. And, although a man of excellent character, he became irritable and forgetful without

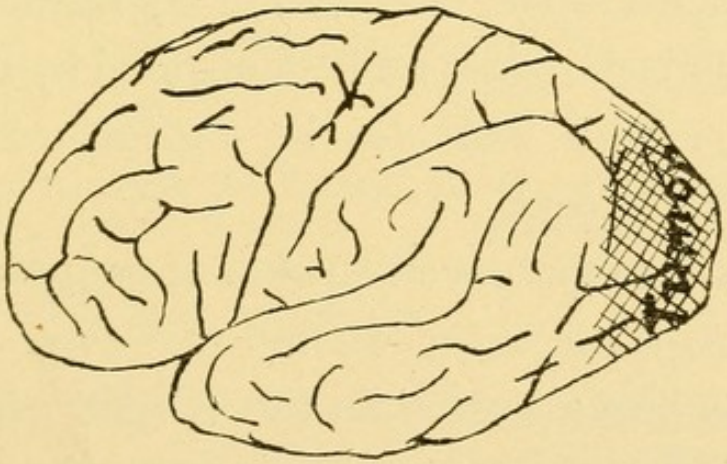


FIG. 9.—Illustrating Drs. Boland and Whitney's case of tumor of the left occipital lobes (visual center) with mental integrity.

the frontal lobes of his brain appearing to be in any way disturbed (20).

In regard to the posterior (occipital) lobes (cen-

ters for vision), Henchen has collected eleven cases in which there existed more or less extensive disease of these lobes without vision being affected, while he found fourteen cases recorded in which the same lobes were diseased without hemianopsia (half vision) being produced (21).

In regard to the visual center in the monkey Ferrier says. "Though the occipital lobes are included in the visual centers it is nevertheless a remarkable fact that they can be injured or cut off bodily almost up to the parieto-occipital fissure on one or both sides simultaneously without the slightest appreciable impairment of vision. This fact, which I have already observed in my former experiments, has been completely confirmed by Professor Yeo and myself and also by Professors Horsley and Schäefer" (22).

In regard to the psychic value of congenital malformations of the brain, we find that even an organ of no less importance than the corpus callosum—that great thick bridge of fibers extending between the two hemispheres of the brain and believed to connect all parts of both in direct relationship—is not an essential for mental or moral integrity, as the following cases will show:

CASE I.—Dr. Alexander Bruce reports a man of ordinary intelligence and good character, and who, for thirteen years, did the work of a porter with perfect satisfaction, and exhibited no notable peculiarities. Yet in this man the corpus callosum was completely absent (23).

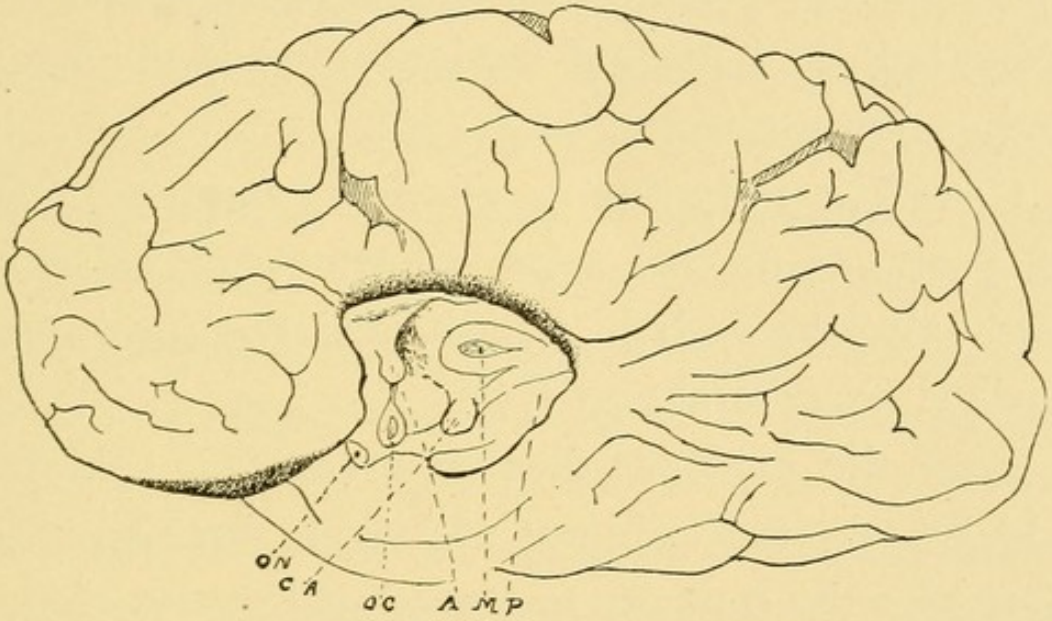


FIG. 10.—Illustrating Dr. Bruce's case of absent corpus callosum with moral and mental integrity. *ON.* Optic nerve. *CA.* Corpora Albicantia. *OC.* Optic chiasma. *A.* Anterior commissure. *M.* Middle commissure. *P.* Posterior commissure.

CASE II.—Malinverni reports a soldier, aged 30 years, of ordinary intelligence, but with a slight tendency to melancholia, who had complete absence of the corpus callosum (24).

CASE III.—Eichler reports a laborer, 43 years of age, married, diligent and capable, a good husband,

sober and quiet, and could read and write, yet he had no corpus callosum, and had other important malformations of the brain (25).

CASE IV.—Paget reports a girl, aged 21 years, of fairly normal mind, trusty, competent, and of good character, whose corpus callosum was only one and one-quarter inch in length (normally it is about half the length of the brain), while the fornix and psalterium were absent (26).

CASE V.—Jolly reports a railway employe, aged 58 years, of normal mind, whose corpus callosum was only one inch in length, and the fornix and psalterium were absent (27).

From the evidence thus far presented, I think it will be admitted without argument that the brain possesses the capacity for functional substitution, a capacity that could not exist if mind and brain were identical. We have seen that even with both sides of the brain considerably damaged, mind may retain its integrity. Thus while mutually mind, vitality, and organic structure are correlated as engineer, energy and engine, the slips and wrecks only go to prove the provisional relationship existing between the two as cause and effect.

Before closing this review a glance at mind and

its relations in the lower animals will enhance our general conception. And first, it may be observed that even micro-organisms exhibit something of mental action by (*a*) perception of the external object, (*b*) choice made between a number of objects, (*c*) perception of position in space, and (*d*) movements calculated either to approach the object and seize it or to flee from it. The earth-worm has no special sense organs—no eyes, no ears, nor organs of smell, and yet it reacts to light, sound, touch, and probably odor (28). Humble in the vertebrate scale is the amphioxus with nothing but an undifferentiated bulbous ending to its spinal cord in lieu of a brain, and yet it possesses will to do a great variety of acts (29). Higher up the scale we find the alert and discriminating fishes, the trout, for example, with no cortex to its brain; and yet fishes display anger, fear, jealousy, pugnacity, social, sexual and parental feeling much as a child four months old (30). Professor McIntosh declares that "fishes show great and acute memory and affection" (31). In the next step along the line of evolution (according to Hæckel and others) we are brought to another jump, for it is found that amphibians possess a brain cortex which has two lay-

ers of cells; and if we continue along the same line (phantom evolution) we must take another jump in cerebral structure, for it is found that in the cerebral cortex of mammals there are no less than four layers of cells. Thus we see that comparative anatomy goes histology one point farther and declares that the possession of a variety of mental faculties—functions or modes of activity—not only does not depend upon a specialized brain cortex, but does not depend upon any cortex whatever, nor even on the possession of a brain. But as power corresponds to the means as well as the motive, the range of the mind's action depends upon the fitness and efficiency of its subservient organs in the process of gathering from a complex environment, so that, the more complex the means the more multiplied are the avenues for giving and receiving—mind as *executive*, and brain as *environment.*

CHAPTER V.

BRAIN FORM IN RELATION TO MIND.

In man the convolutions of the brain differ even more than do his face features, while comparative

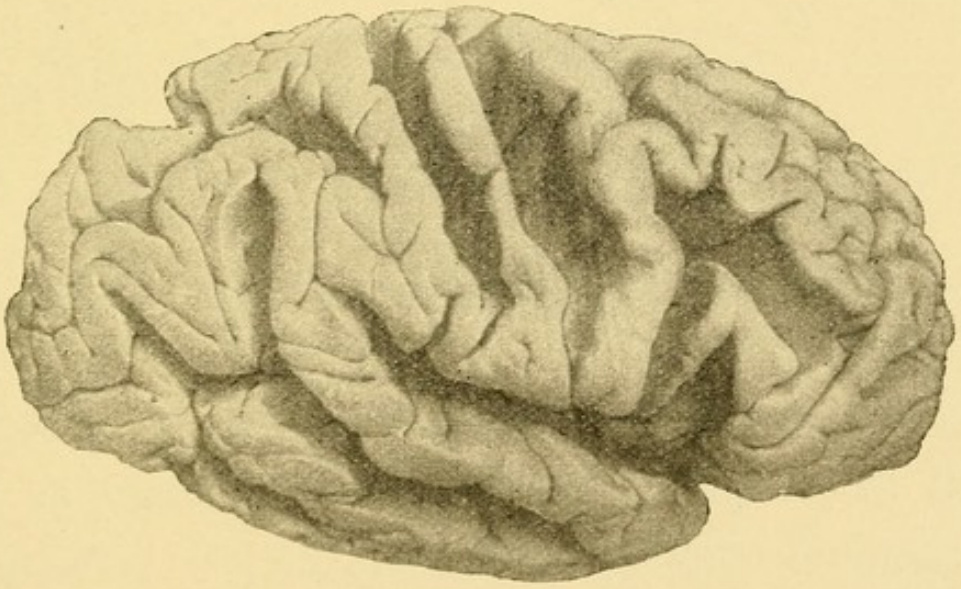


FIG. 1.—Human brain, right hemisphere, showing the depth of the deepest fissures. (After Cunningham.)

anatomy shows that no animal brain has so numerous, deep and unsymmetrical convolutions in both hemispheres. Parker has shown that they develop in an orderly manner (1), while in their early stages

they seem in some way to be related to the development of the sense organs (2). In some carnivora, ruminants and apes, they are strictly symmetrical in both hemispheres, while in some cetacea (*e. g.*, whales) they are more numerous, but the fissures are only a few lines deep in many places (Bischoff). They apparently bear no relation to mental status, for some of the most stupid creatures known to us, as the ass, sheep and ox, are rich in convolutions,

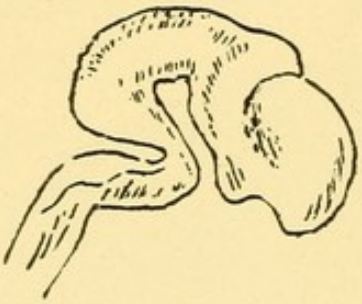


FIG. 2.—Brain of a one-month human embryo.

FIG. 3.—Brain of a two-month human embryo.

and they even exist quite distinctly in animals of a much lower grade in the biologic scale, as the echidna and macropus (2), while they are absent in animals which in other respects are more highly organized, as birds, bats, castors, squirrels, beavers and marmoset apes. According to Turner, in some natural orders, one species may have convoluted brains, while in another species of the same order there are no convolutions (2).

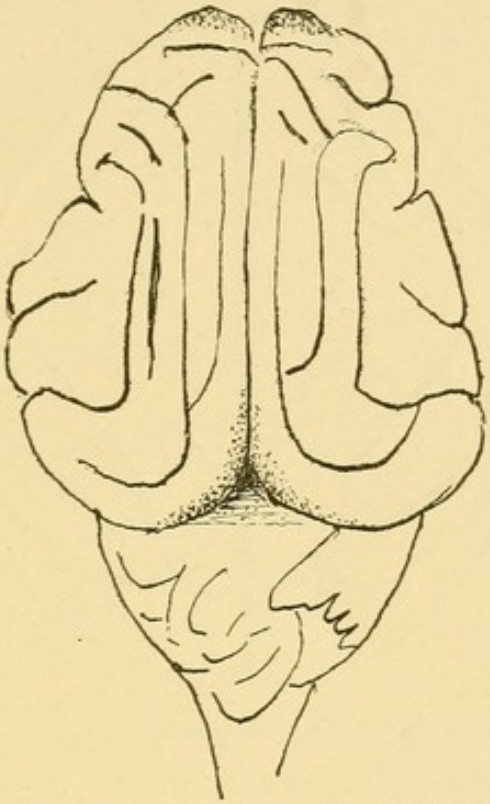


FIG. 4.—Brain of a cat; top view, frontal lobes facing upwards. (After Ferrier.)

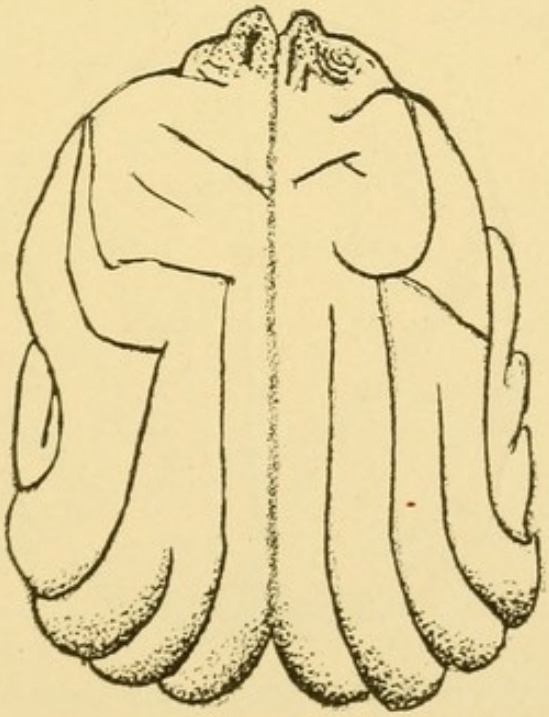


FIG. 5.—Brain of a dog; top view, frontal lobes facing upwards. (After Ferrier).

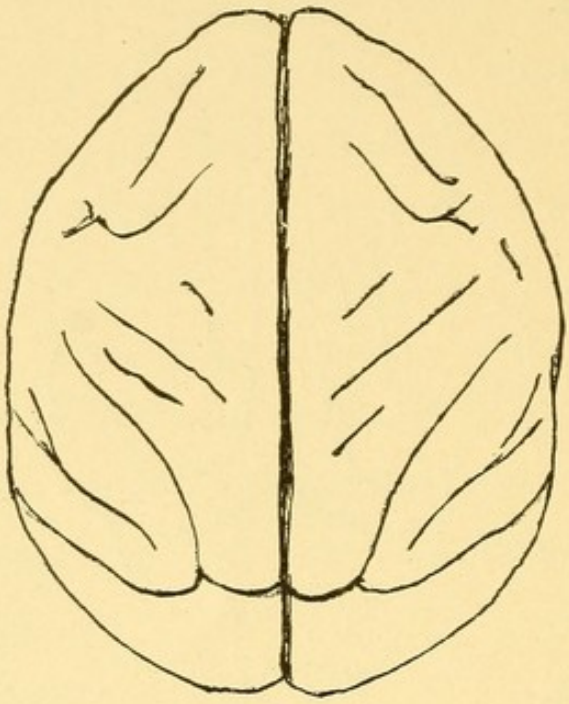


FIG. 6.—Brain of a Monk monkey, showing symmetry of convolutions; top view, frontal lobes facing upwards. (After Ferrier.)

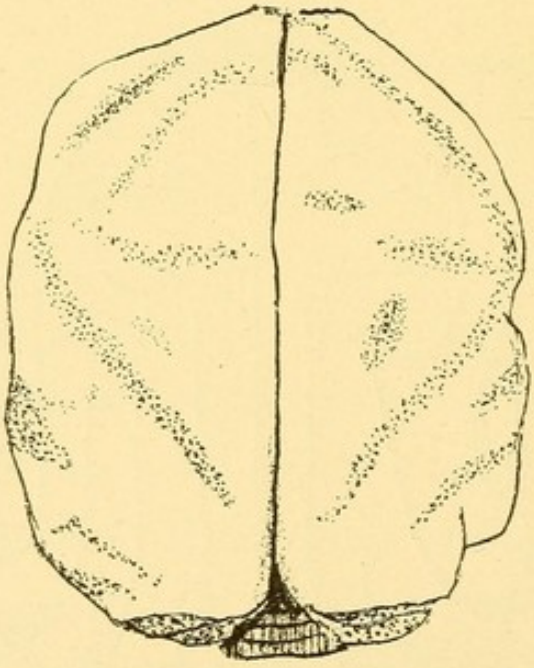


FIG. 7.—Brain of a Howler monkey; top view, frontal lobes facing upwards. (After Ferrier.)

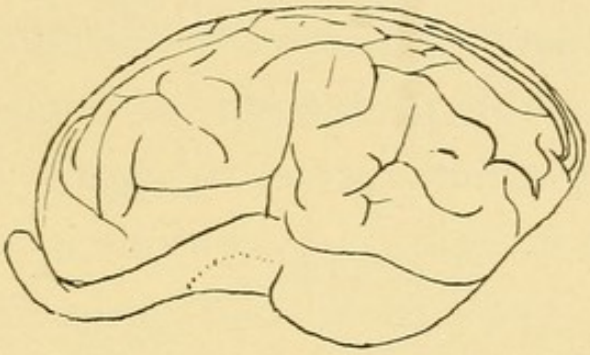


FIG. 8.—Brain of a sheep; left side view. (After Turner.)

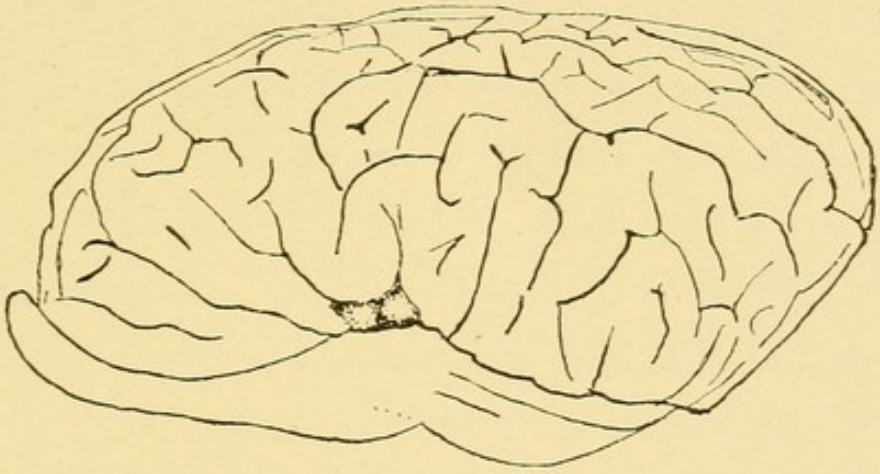


FIG. 9.—Brain of a horse; left side view, showing the fissures and convolutions. (After Turner.)

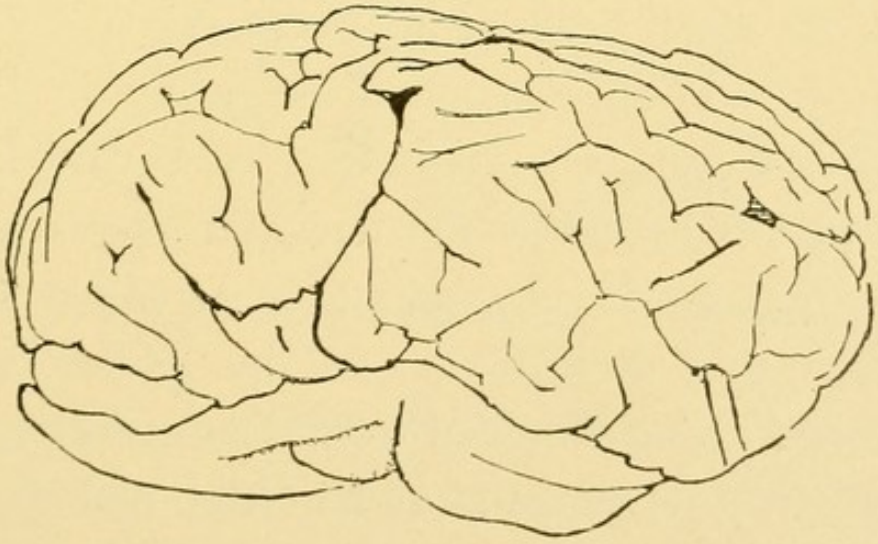


FIG. 10.—Brain of an ox; left side view, showing the fissures and convolutions. (After Turner.)

Mivart states that forms zoologically distinct are found to resemble each other in brain characters, while closely allied forms strangely differ. For example, the bridging convolutions in man, extending between the parietal and occipital lobes, also exist in the spider monkeys, although they are absent in most of the higher apes, while, observes Mivart, "two species of sapajou (cebus) so closely allied as to have been treated as one species differ strangely from each other in this respect" (3). Turner observes that in the brains of mammals so far apart as *echidna* and *homo*, the gyrus dentatus has a denticulated appearance in its gray matter, while in most mammals it is smooth (2). This convolution does not increase in size with the brain; *e. g.*, in the small brain of the hedgehog it is 3 mm. broad, while in the very much larger brain of the horse it is 6 mm. (2). According to Mivart, in the little squirrel monkeys the occipital convolutions extend backwards beyond the cerebellum much more than they do in man. In the gibbon, chimpanzee and orang the third frontal convolutions are very slightly developed, and in the embryos of these animals they are the last to develop, whereas in man they are the first. The same is the case

with the temporal convolutions, which in man are late, but in apes they are among the first to appear.

Benedict of Vienna claims that when the convo-

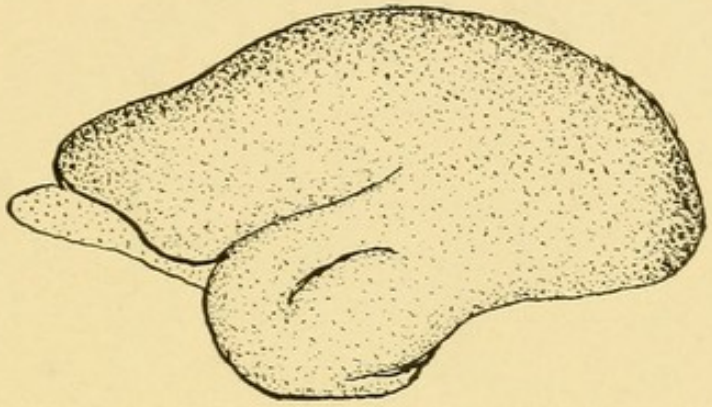


FIG. 11.—Brain of a marmoset ape; left side view. (After Turner.)

lutions are deficient in development there is a consequent excess of fissures, which he regards as a fundamental defect. But it will be observed from

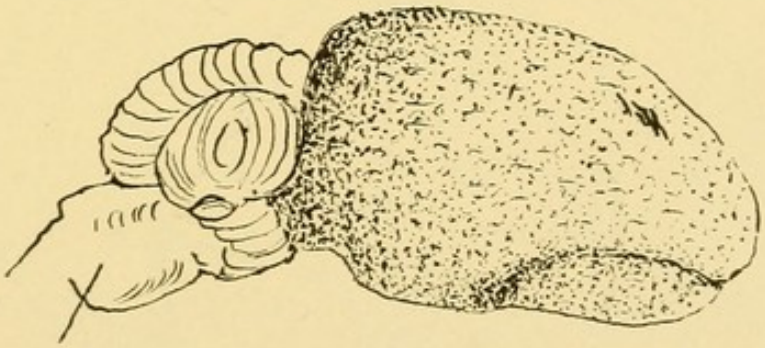


FIG. 12.—Brain of a beaver; right side view. (After Cassel's Natural History, Vol. IV.)

the figures presented that the brain of Gauss, the eminent mathematician, is decidedly excessive in fissures, while the brain of Chauncey Wright, another eminent mathematician, is described by Wilder

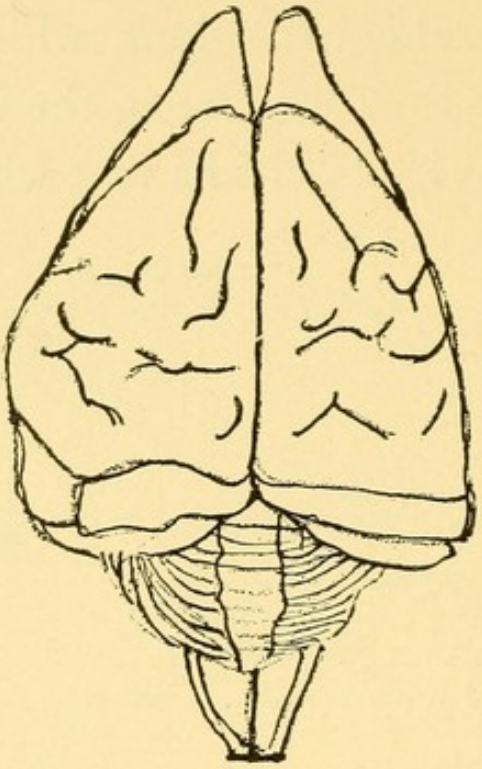


FIG. 13.—Brain of an echidna; top view, frontal lobes facing upwards. (After Turner.)

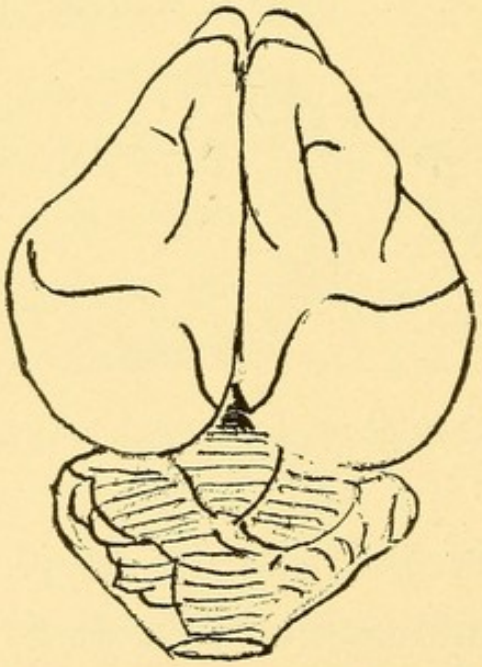


FIG. 14.—Brain of a macropus, the cerebrum facing upwards and the cerebellum downwards. (After Turner.)

as being remarkable for the flatness of its convolutions, and the simplicity of its fissures, the central fissure (Rolandic) being completely interrupted (5),

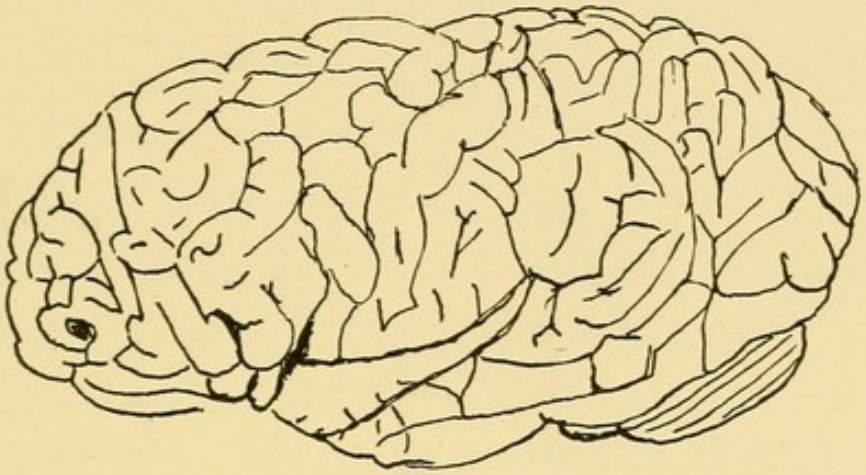


FIG. 15.—Brain of Gauss, the eminent mathematician, showing an excess of fissures. Frontal lobes facing to the left. (After R. Wagner.)

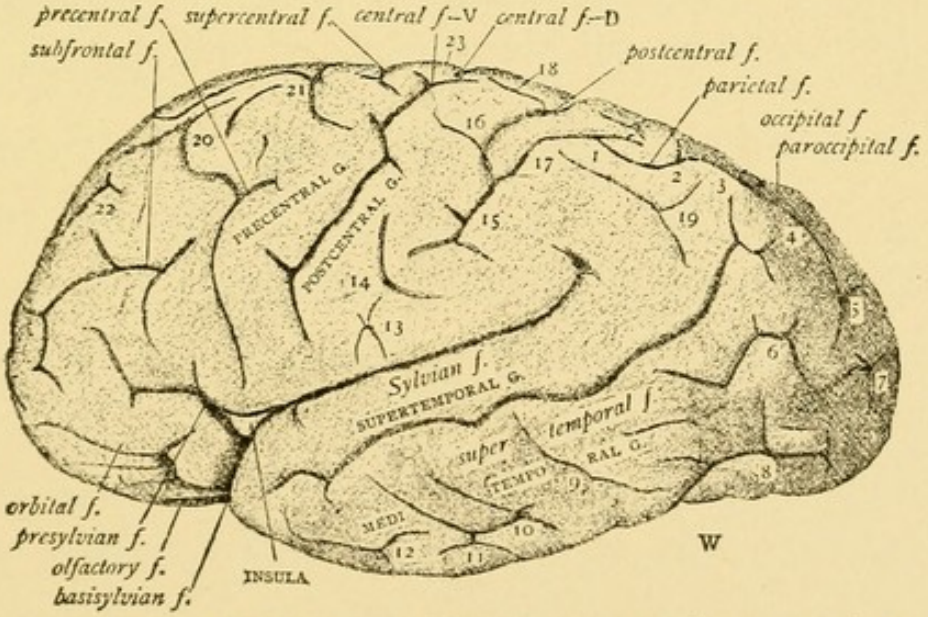


FIG. 16.—Brain of Chauncey Wright, the eminent mathematician and philosopher, showing unusual simplicity of convolutions and an interruption of the central fissure which existed on both hemispheres. Prof. Dwight (Harvard) describes this brain as being simpler in convolutions than that of a Venus Hottentot (a form of African idiot). (After Wilder.)

as was also the case in the brain of Fuchs the physician (6). Marshall describes the convolutions of

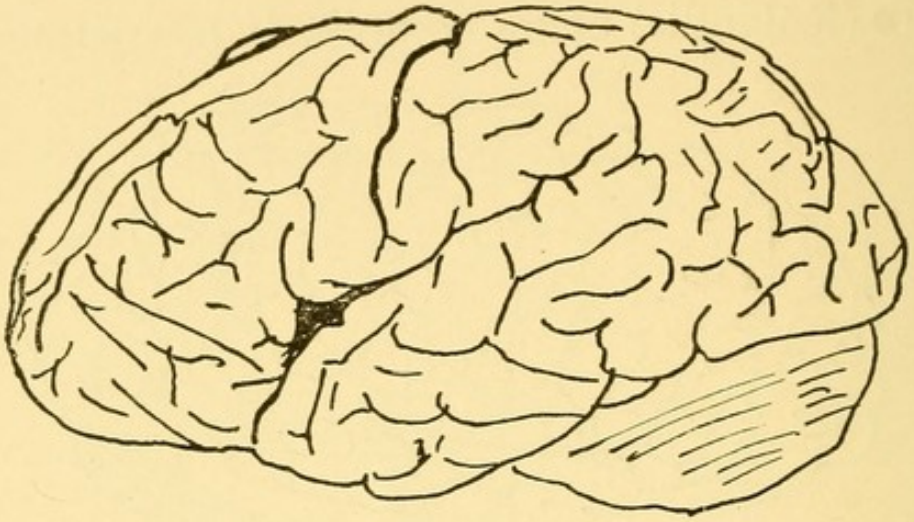


FIG. 17.—Brain of Gambetta; left side view. (After M. M. Chudzinski and Duval, Bulletin De La Societie Anthropologie de Paris, 1886.)

the brain of Grote, the historian, as "broad, making the appearance of simplicity of markings" (7).

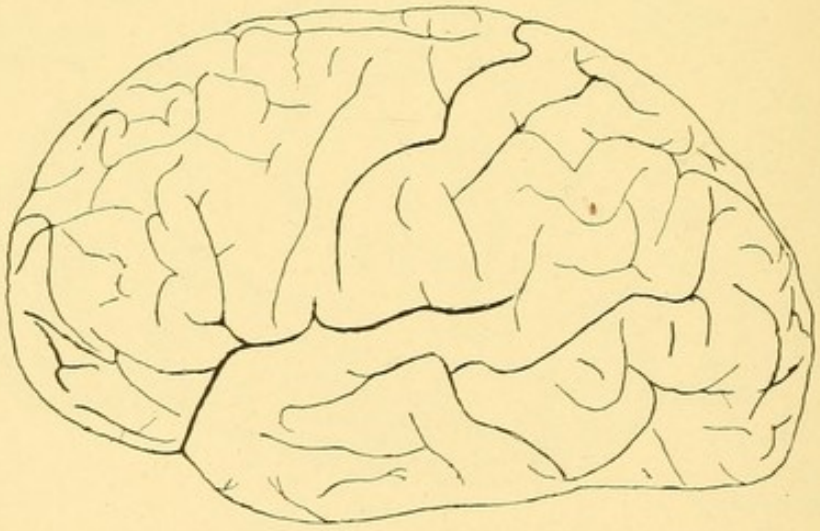


FIG. 18.—Brain of a Hungarian carpenter, showing excessive convolutions. (After Wilder.)

Asseline, Tiedeman and Liebig are reported to have had small convolutions.

Benedict has also stated that he has observed frequent confluence of the fissures among some lower races, and an additional convolution in the frontal lobe. But Giacomini of Turin and others have shown that similar anomalies exist in normal brains, though less frequently. Wilder says, in reference to interruption of the occipital fissure in the human brain: "In eight brains of moral and educated persons the isthmus (paroccipital) is complete on the right side in six, and on the left in only one. When all classes are included, of the twenty-six complete interruptions twenty-one are right and only five left. Occasionally there is an isthmus on both sides or only a vadum. The most common combination is an isthmus on the right side with a vadum on the left" (8).

In 2174 hemispheres Heschl found complete interruption of the central fissure in six (17), while Eberstaller twice found it in two hundred brains. The same convolutional interruptions are observed in the higher apes, while in these animals the central fissure is relatively much longer than it is in man (18).

Eichler reports a laborer, 43 years of age, in whom the calloso-marginal, parieto-occipital and

calcarine fissures were indistinguishable and the gyrus fornicatus absent or indistinguishable. In addition to all that, his cerebral hemispheres were asymmetrical, and the corpus callosum was totally absent. Yet Eichler says this man was married,

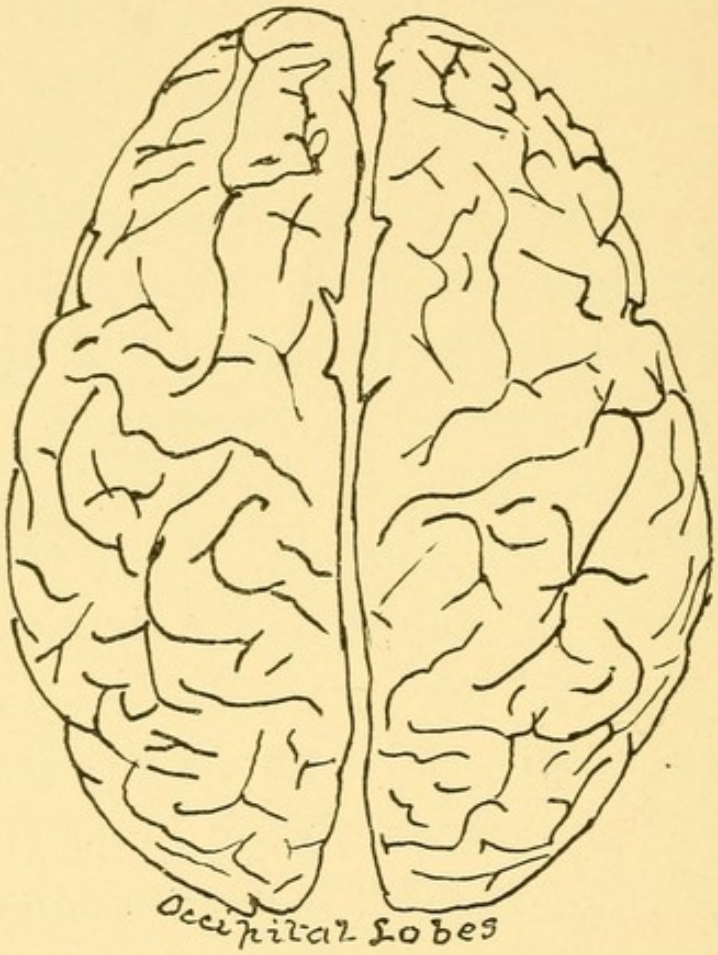


FIG. 19.—Brain of Gambetta. Top view.

diligent and capable, a good husband, sober and quiet, and could read and write (9).

According to Cunningham, "The convolutions and sulci on the brain of a microcephalic idiot may assume an arrangement which approaches more

closely to the ape-type than the man-type, and the significant point is that in these cases there is a mixture of these characters which are distinctive of a high ape with those which are characteristic of a low ape. The general arrangement may differ widely from that seen in the brain of any one ape, but it presents certain features which are peculiar

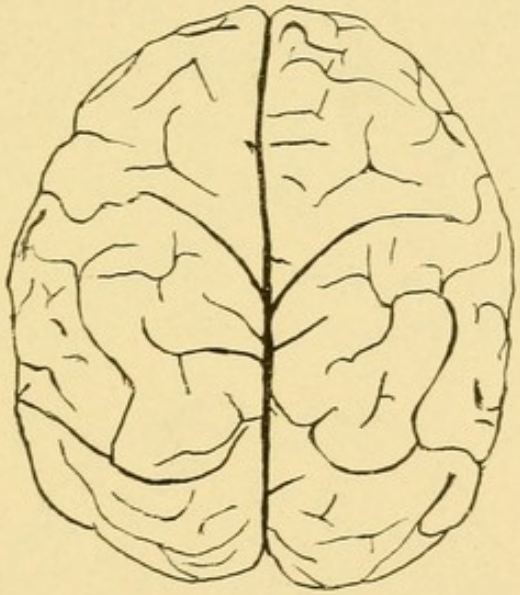


FIG. 20.—Brain of a chimpanzee; top view, frontal lobes facing upwards. (After Turner)

to an anthropoid and others which are characteristic of, say a baboon or a macaque. From this we conclude that in so far as the convolutionary arrangement is concerned the brain has reverted wholly or in part to a condition which existed previously in an early stem form" (10). The last sentence assumes that the theory of atavism is a fact.

Krause of Berlin has described the brain of an "ape-like boy," seven and a half years of age, as being of "normal size, but differed from the human

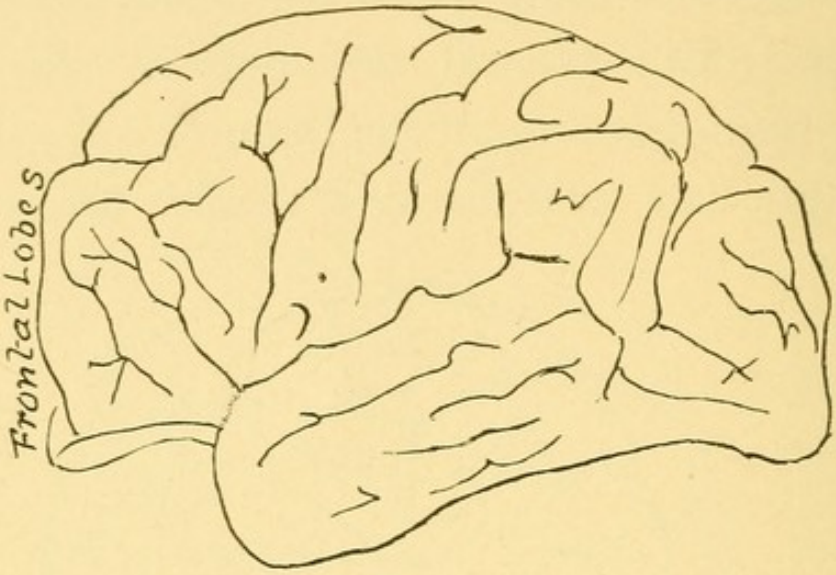


FIG. 21.—Brain of an orang; side view. (After Gratiolet.)

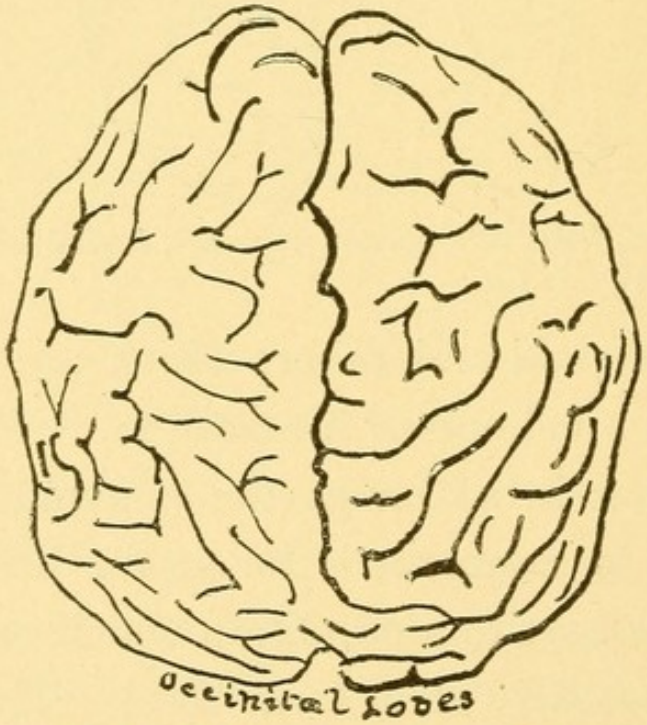


FIG. 22.—Brain of an orang; top view. (After Bastian, from a brain in the Royal College of Physicians, London.)

in every respect and approached in its whole structure to the simian rather than the human type." The

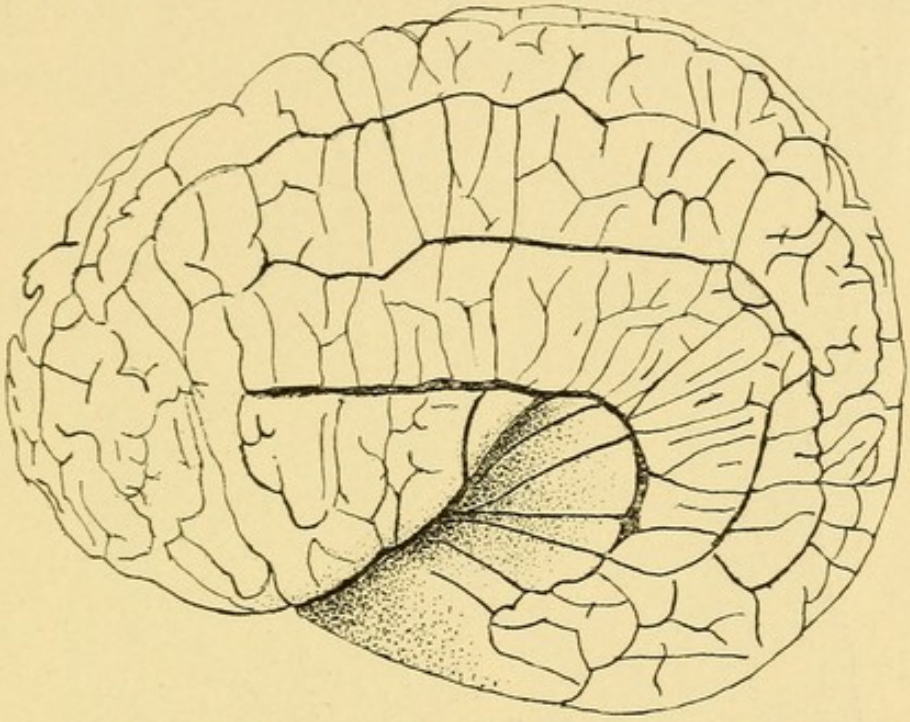


FIG. 23.—Brain of a Narwhal; left side view. (After Turner.)

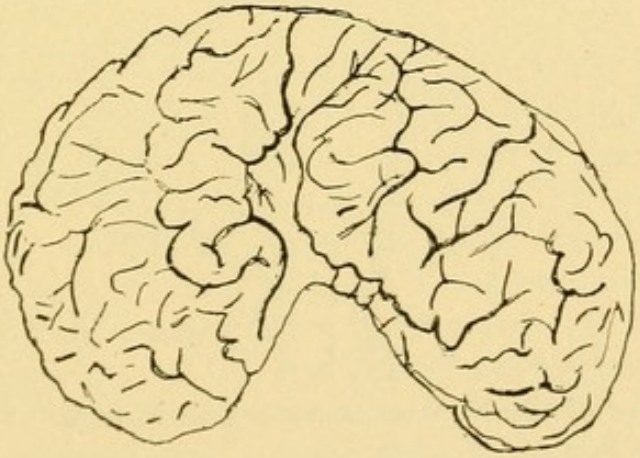


FIG. 24.—Brain of an elephant. (After Bastian)

boy was cheerful and inclined to play and dance, but passionate when teased. He could only say "pa pa, ma ma." His parents had neglected him.

Virchow and Hartman made a careful and close study of this boy, as they likewise did of Margaret Becker, another "ape-like" idiot, yet both these authorities concur in the decision that "in these ab-

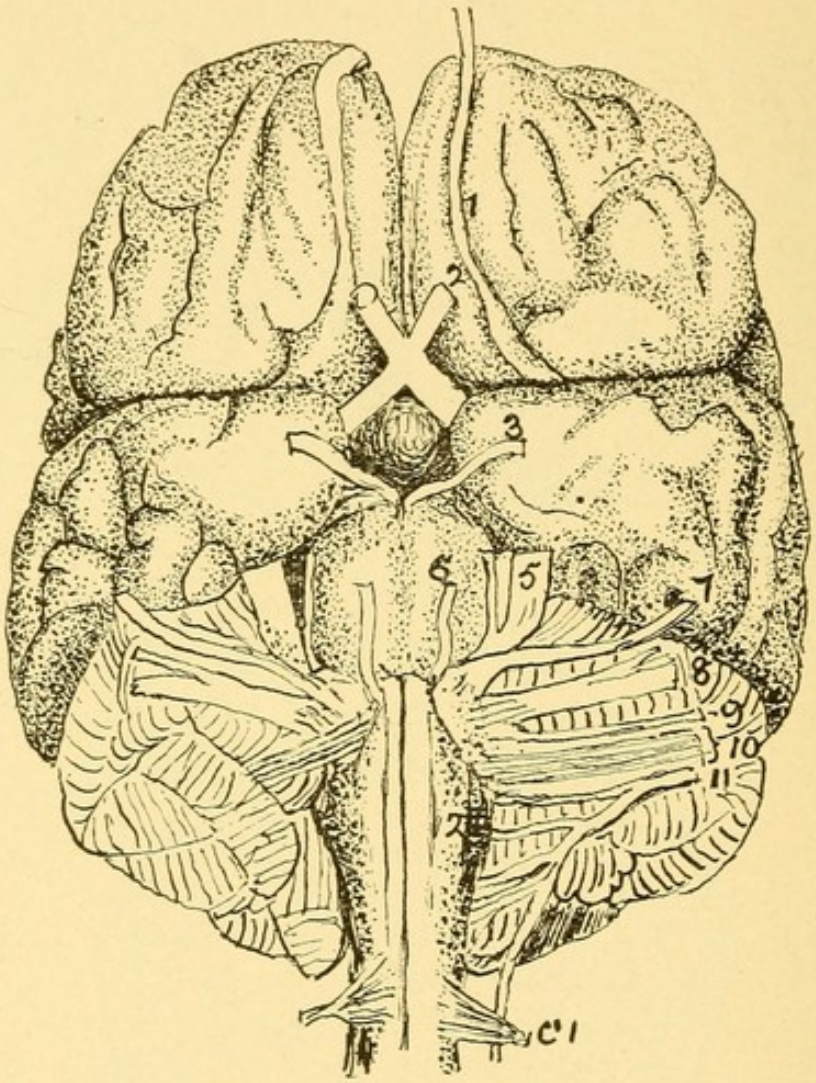


FIG. 25.—Base of the brain of a microsmatic seal. (After Turner)

normal creatures the positive psychologic faculties and qualities of the ape are wanting, while every characteristic of a human being is present" (11).

Luciani reports a woman, 48 years of age, who

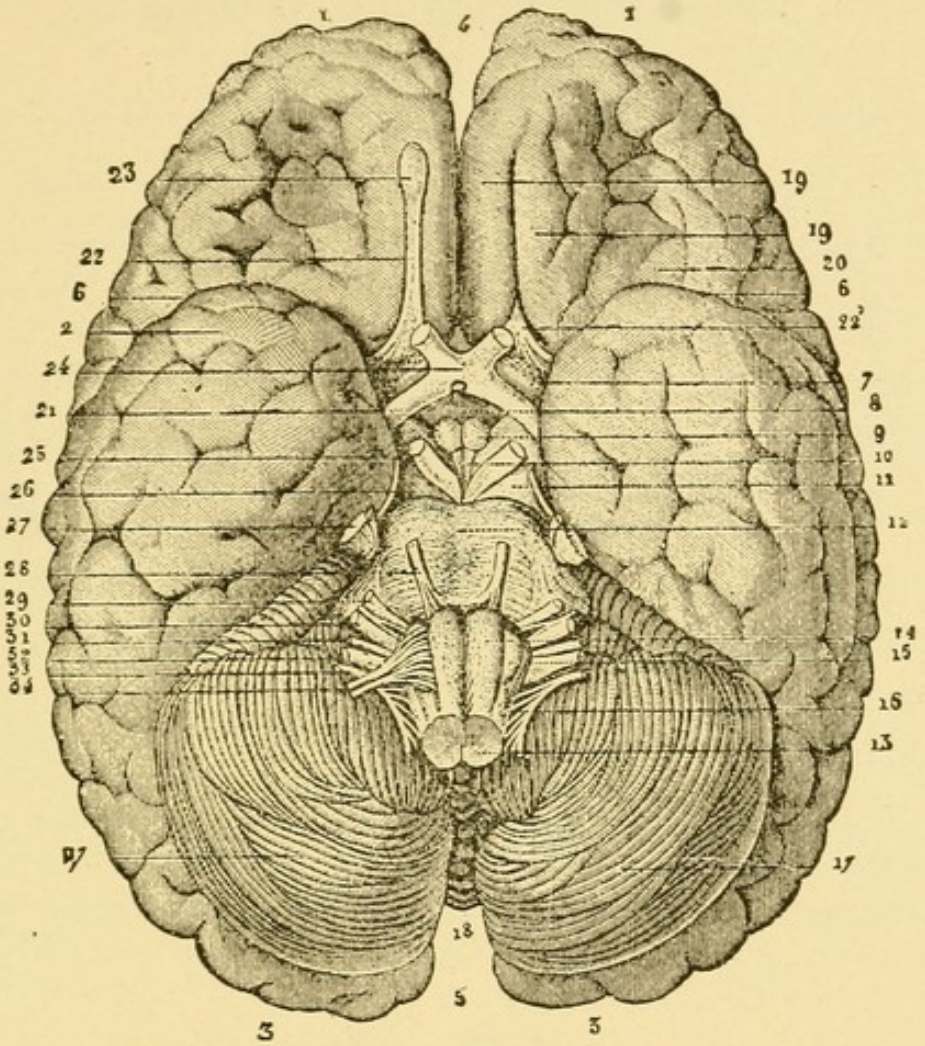


FIG. 26.—The base of the human brain. (After Hirschfeld.) 1, 1, anterior lobe of the cerebrum; 2, sphenoidal portion of the posterior lobe; 3, 3, occipital portion of the same lobe; 4, anterior extremity of the median fissure; 5, posterior extremity of the same; 6, 6, fissure of Sylvius; 7, anterior perforated space; 8, tuber cinereum and pituitary body; 9, corpora albicantia; 10, interpeduncular space (posterior perforated space); 11, crura cerebri; 12, pons Varolii; 13, medulla oblongata; 14 anterior pyramids; 15, olivary body; 16, restiform body (only partially visible); 17, 17, hemispheres of the cerebellum; 18, fissure separating these hemispheres; 19, 19, first and second convolutions of the inferior aspect of the frontal lobe with the intervening sulcus; 20, external convolutions of the frontal lobe; 21, optic tract; 22, olfactory nerve; 22′, section of the olfactory nerve, showing its triangular prismatic shape: the trunk has been raised to show the sulcus in which it is lodged; 23, ganglion of the olfactory nerve; 24, optic chiasm; 25, motor oculi; 26, patheticus; 27, trigeminus; 28, abducens; 29, facial; 30, auditory nerve and nerve of Wrisberg; 31, glosso-pharyngeal; 32, pneumogastric; 33, spinal accessory; 34, hypoglossal.

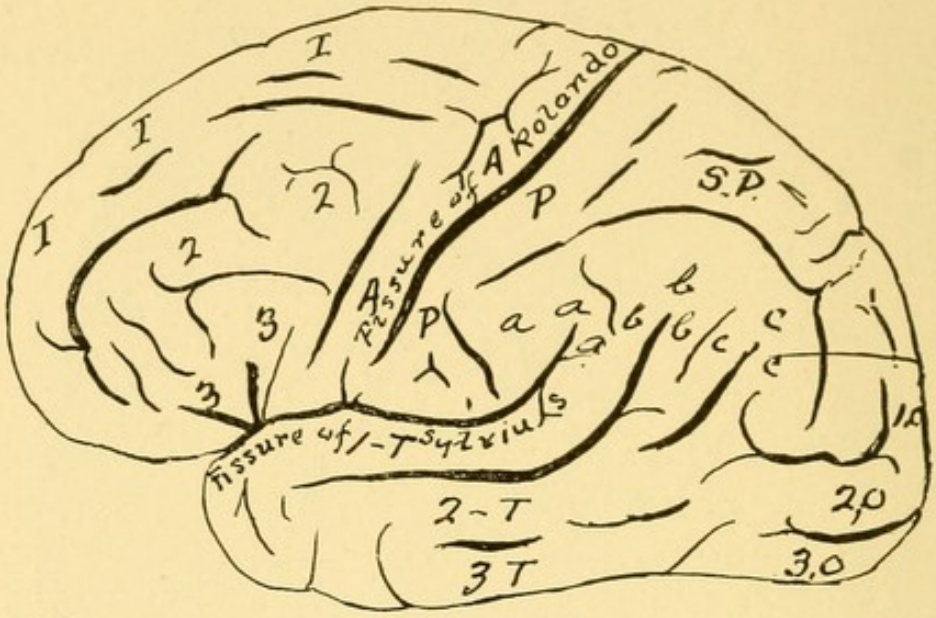


FIG. 27.—Diagram showing the location of the convolutions as named. 1, 2 and 3 indicate the superior, middle and inferior frontals. *A*—ascending frontal or pre-central; *P*—ascending parietal or post-central; *S. P.*—superior parietal; *a*—supra-marginal; *b*—angular; *c*—posterior parietal; 1 o, 2 o, 3 o, superior, middle, and inferior occipital; 1-T, 2-T, 3-T, superior, middle, and inferior temporal convolutions.

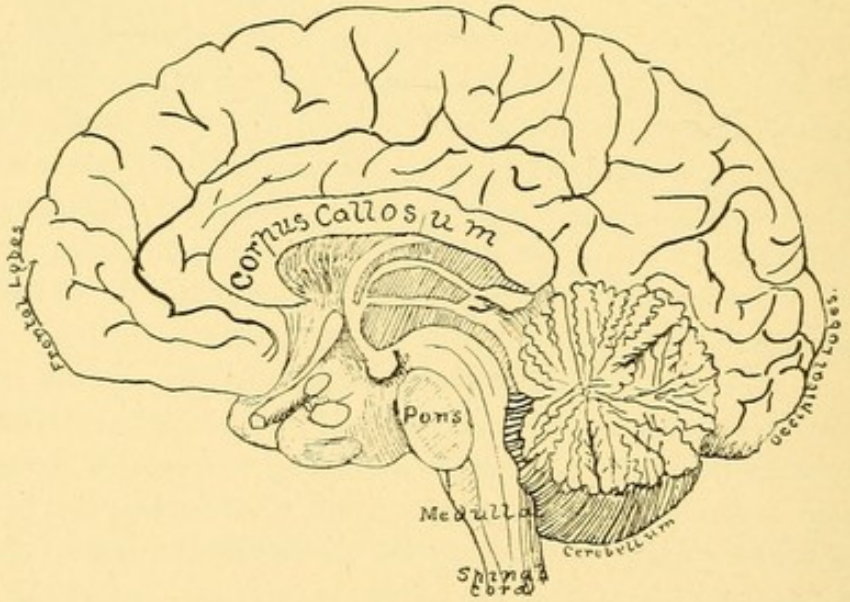


FIG. 28.—Human brain; inner side of one half, showing the fissures of the cerebrum, etc. (After Diebierre).

had a brain weighing only 900 gm., and with "marked abnormality of the convolutions." "The inferior pre-central fissure ran into the ascending ramus of the sylvian fissure; the second temporal fissure ran into the occipital fissure," which is said to be a rare abnormality. Yet "her intelligence was average," and she had lived a regular life, without attracting any peculiar attention until shortly before she died of pneumonia (12). R. Wagner refers to two cases of good intelligence with few convolutions (13).

Occasionally infants are born without convolutions in the brain. Taylor describes one, eight months old, with a brain entirely devoid of convolutions, while the surface of the brain had the appearance of being covered with plaster. Otherwise "it had no marked gross defects. It was defective mentally, and had frequent convulsive seizures of a peculiar character" (14).

From the foregoing facts it is quite evident that while brain convolutions have in all probability a psychic value of some kind in the way of "character" qualities other than moral, they bear no direct relation to mental status in either the biologic scale or class peculiarities. On the one hand we see the

resourceful beavers skilfully co-operating in the adaptation of complicated means for social purposes, and even under exceptional conditions, while on the other hand, the sheep, with a brain rich in convolutions, is one of the most helpless and stupid of creatures under any unusual circumstances.

HEAD FORMS.

In regard to the shape of the head, it seems that most of our race types are dolichocephalic (long-headed), while all forms are, as a rule, found scattered among all races. Among the less civilized races it is frequently the case that a particular form is universal, or almost so, in a particular tribe, even in a race with all forms. According to Dr. John Rae (15), Eskimos in the neighborhood of Behring Straits are brachycephalic (short-headed); those inhabiting Greenland are extremely dolichocephalic, while the natives of the intermediate coast from Coppermine River eastwards have mesocephalic heads (intermediate shape). The Andamanese, a race of small people in the Indian Ocean, are said to be remarkable for the uniformity in the shape and smallness of their skulls (16).

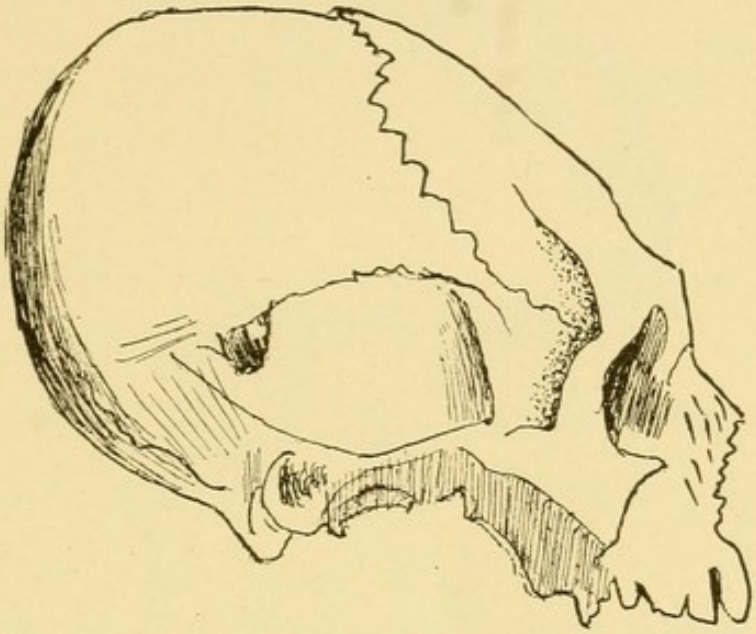


FIG. 29.—Chinook "flat-head" skull, artificially deformed in infancy. (From Cassel's Natural History, Vol. VI.)

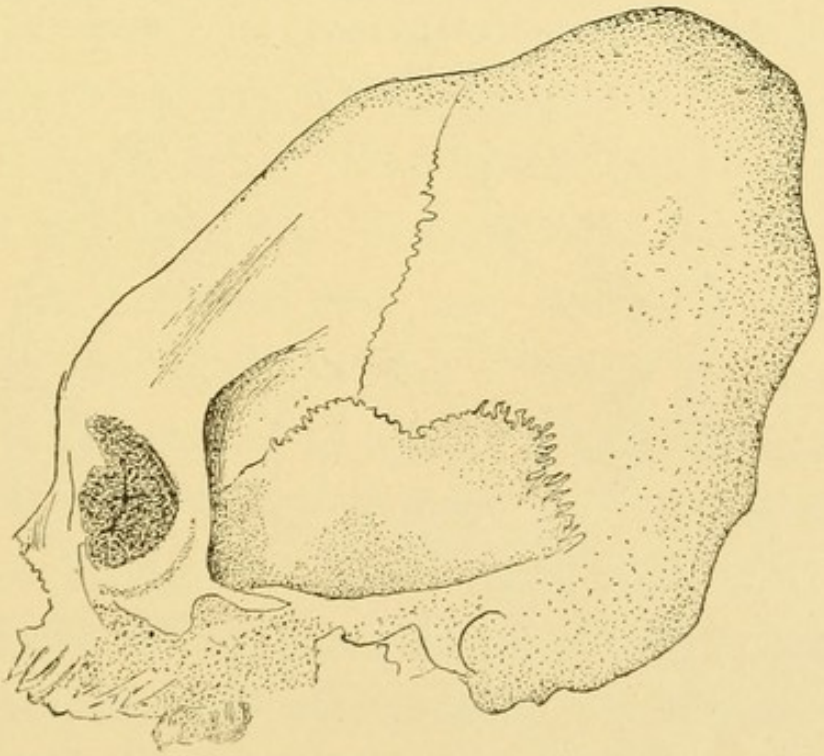


FIG. 30.—"Flat-head" skull from Mallecollo, artificially deformed in infancy. (In the Museum of the Royal College of Surgeons, England.)

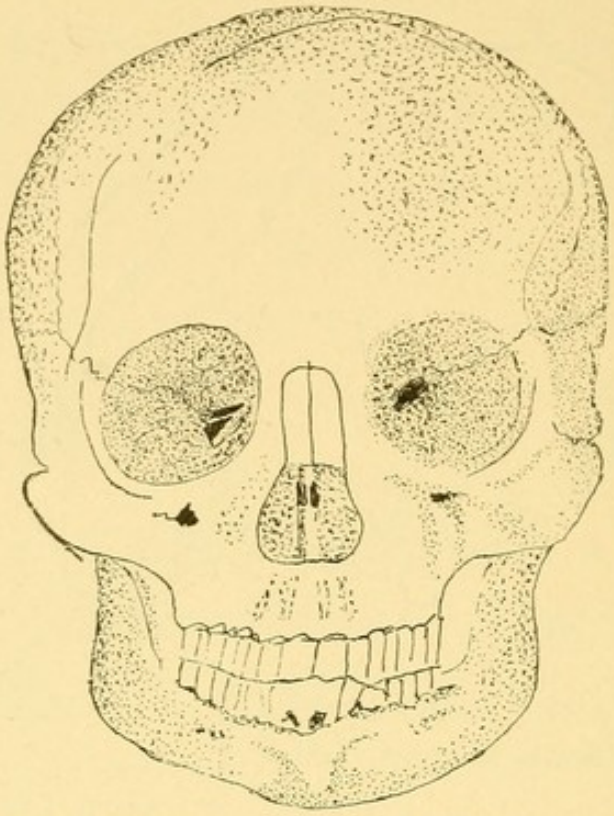


FIG. 31.—An Andamanese skull. All their skulls are remarkably similar, and about the smallest of any race. (After Flower.) (17.)

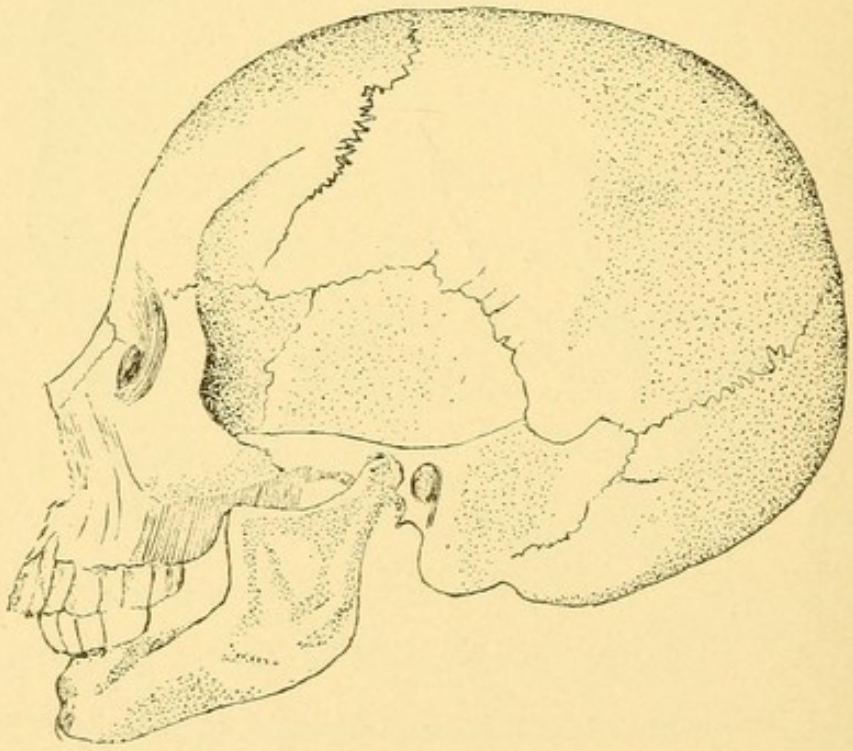


FIG. 32.—Andamanese skull.

CHAPTER VI.

BRAIN SIZE IN RELATION TO MIND.

We have seen that brain weight is practically a measure of brain size (page 30). Brains weighing less than 1000 gm. are designated microcephalic, the average male brain weighing about 1400 gm. Very few brains are microcephalic, and according to Dr. Ireland even among idiots only one per cent. are microcephalic, and the brains of these are human in structure. Their basal ganglia and cerebellum are not proportionately diminished, and all other parts of the body are normally developed. Dr. Ireland reports a girl, 12 years of age, whose brain only weighed 224 gm. She never spoke, was always fed, and her highest accomplishment was to shake hands (1). Prof. Cardova and Dr. Adriani of Perujia report the case of Antonio, an Italian idiot, whose brain only weighed 284 gm. (cerebrum 238 gm.) She could dance, play well on the cym-

bals, was fond of being noticed, especially by the opposite sex, had a good memory for names of places and persons, but none for time. She learned to do easy work in the house and go out to buy provisions (2).

But, as a rule, although some microcephales are active and energetic, they have little power of continuous attention, while their sense impressions are lively. They are restless, imitative, and inclined to fly into passions. Few can speak. Under a special system of education they improve.

Dr. Langdon Down observes four types among feeble-minded children, according to their general characteristics, both physical and mental, viz., (*a*) the Mongolian; (*b*) the Malay; (*c*) the North American, and (*d*) the Negroid. He found 10 per cent. were of the Mongolian type, and all brachycephalic with "the posterior part of the head ill-developed." Their hair is usually brown, straight and sparse; face flat and broad, and destitute of prominence; cheeks roundish and widened laterally; eyes obliquely placed, and the internal canthi more than normally separated; lips large and thick; nose small; tongue large, thick and rugous; skin tawny. They had always great powers of imitation, and

became extremely good mimics and had a strong sense of the ridiculous. They were always amiable both to their companions and animals, but neither passionate nor strongly affectionate. They could usually be taught to speak, though indistinctly and harshly.

The Malay type has soft, black, curly hair, prominent upper jaws, and capacious mouths, as in the South Sea Islanders.

The North American Indian type has shortened forehead, prominent cheeks, deep-set eyes and slightly apish nose.

The Negroid type has characteristic malar bones, prominent eyes, puffy lips, and retreating chin; woolly hair, but not black, and without pigment in the skin. The same authority observes that the faculty of number is usually but slightly developed in feeble-minded children, while memory is fairly well developed, especially memory for tune, as they readily acquire simple airs, and seldom forget them. Some few are possessed of remarable talent in narrow channels. Down tells of a boy who was a marvelous crayon-drawer, but a comparative blank in all his higher faculties. Another boy could build exquisite model ships from drawings, and carve

with a great deal of skill, but he could not understand a sentence, and had to have his food dissected for him. Another boy, 12 years of age, could multiply three figures by three figures with perfect accuracy, and so quickly that the listener could hardly write the six figures on paper before the result was given. Yet this boy, although he had talked with Dr. Down daily for two and a half years, could not remember the doctor's name. Another boy had a perfect appreciation of past or passing time, being able to tell the time to a minute at any part of the day and in any situation. He was tested on numberless occasions, but gradually his responses became less ready, his health became enfeebled and the faculty lost. He was 17 years of age at death, and the autopsy revealed his brain to be an ordinary one except that he had two well marked and distinct soft commissures. Dr. Down mentions a number of other similar cases, and remarks that none of them can explain how they do their feat (3). Dr. E. S. Boland reports a blind negro youth at the Perkins Institute, Boston, who was as wonderful at rapid numerical computations as Blind Tom was at reproducing musical compositions which he had only once heard. Also another boy

who could answer questions as to calendar dates in his past life, and for a year or two in the future (25). Dr. Down observes that in none of these idiot prodigies, which have all been males, have any like faculties been found in their family relatives (3).

Sir F. K. Bateman defines an idiot as "a being who possesses the tripartite nature of man, body, soul and spirit, but who is the subject of an infirmity consisting anatomically of a defective organization and want of development of the brain, resulting in an inability, more or less complete, for the exercise of the intellectual, moral and sensitive faculties" (4).

In a considerable proportion of idiots and imbeciles, including the paralytic forms, the mental defects are due to positive disease of the brain tissue rather than an arrest of development, while in many cases, including the microcephales, the mental defects are due to arrest or abortive development of the tissues of the cells and fibers. The late Hammarberg of Sweden most thoroughly studied the brains of some idiots, of which the following case is illustrative of his findings in an extreme degree of idiocy: "An idiot, 14 years of age, of normal stature, died of pneumonia. She never learned to sit or walk, nor showed any attention to things go-

ing on about her. She had no ability to help herself in any way except to cry when hungry. All traces of speech and the recognition of things or persons were totally wanting. Her brain weighed 442 gm.; the hemispheres were unsymmetrical; the insula was lacking or represented on the surface by two accessory frontal convolutions; the corpus callosum was membranous and the fornix defective; a number of the important fissures were not represented and considerable areas were unconvoluted; the cerebellum showed no abnormality, but the pons was unsymmetrical. The cells in the brain numbered two, three, or four, never more than ten per 0.1 cubic mm., and these were simply spindles or granules. The cortex in several regions had only a single layer of embryonic cells with no trace of the ordinary differentiation. In other parts there were two layers—a superficial layer of cells partially grown into the pyramidal shape, and a deeper layer of simple spindle-shaped cells" (5). Thus, for extensive areas, the cortex had not developed beyond the embryonic sixth month, while other areas apparently developed for a month or two longer. In no place had the cells attained anything like the adult normal in size and form. The power to form

cells was also markedly deficient, there being only two to four cells per cubic mm., whereas the normal number is from ten to twenty, and frequently much more (5). In this case we see that the defective structure clearly accounts for the defective mental manifestation.

The peculiar talents sometimes observed in those otherwise backward or idiotic would seem to have their only explanation in the law that an endowment carries with it a corresponding demand for exercise, so that a disproportion in the capacity for exercise existing among organs of the brain may beget an exclusiveness at the expense of the defective organs. Even assuming that the defective development of some parts of the brain does not imply a positive advantage to other parts, yet the relatively more advanced organs will be functionally called upon in excess of their normal share by way of compensating for those organs defective, and thus as a correlative to the favored organs attention will become more and more exclusive or specialized, and so perceptiveness along special lines becomes exceptionally keen but intuitive in form. In support of this view we have the occasional observation that boys who had wonderful special talents have

not only lost them by the process of a liberal education, but have invariably been reduced to mental mediocrity, or even lower still.

BRAIN WEIGHTS OF EMINENT MEN.

WEIGHING LESS THAN 1300 GRAMS.

Age.	*Name.*	*Occupation.*	*Weight.*
71	Dollinger.	Anatomist.	1207
77	Hauseman.	Mineralogist.	1226
40	Harless.	Physiologist.	1238
57	Lasauix.	Physician.	1250
79	Tiedeman.	Anatomist.	1254
80	Grant.	Anatomist.	1290
43	Gambetta.	Statesman.	1294

WEIGHING LESS THAN 1400 GRAMS.

50	Coudereau.	Physician.	1312
63	J. Hughes Bennet.	Physician.	1332
71	Tallymerayer.	Historian.	1344
70	Liebig.	Chemist.	1352
52	Herman.	Philologist.	1358
71	Whewell.	Philosopher.	1390
62	Bertillion.	Anthropologist.	1398

WEIGHING MORE THAN 1400 GRAMS.

45	Assazat.	Political writer.	1403
78	Babbage.	Mathematician.	1403
75	Grote.	Historian.	1410
62 (?)	Meyer.	Poet.	1415
59	Dupuytren.	Surgeon.	1436
73	Helmholtz.	Physicist.	1440
63	Lamarque.	General.	1449
79	Ch. H. Bischoff.	Physician.	1452

WEIGHING MORE THAN 1400 GRAMS—CONTINUED.

Age.	*Name.*	*Occupation.*	*Weight.*
39	Skobiloff.	General.	1457
49	J. Huber.	Philosopher.	1468
56	Broca.	Anthropologist.	1485
78	Gauss.	Mathematician.	1492
65	De Morgan.	Mathematician.	1498
52	Fuchs.	Pathologist.	1499
	WEIGHING MORE THAN 1500 GRAMS.		
67	Chalmers.	Theologian.	1502
56	Schleich.	Writer.	1503
66	Agassiz.	Naturalist.	1512
45	C. Wright.	Mathematician.	1516
70	Daniel Webster.	Statesman.	1516
82	Campbell.	Lord Chancellor.	1516
54	De Morney.	Statesman.	1520
55	Derichlet.	Mathematician.	1520
60	J. Y. Simpson.	Physician.	1533
57	Spurzheim.	Phrenologist.	1559
73	Herman.	Economist.	1590
	WEIGHING MORE THAN 1600 GRAMS.		
54	Goodsir.	Anatomist.	1629
53	Thackeray.	Novelist.	1644
	WEIGHING MORE THAN 1700 GRAMS.		
64	Abercrombie.	Physician.	1785
46	Schiller.	Poet.	1785
63	Cuvier.	Naturalist.	1830
	WEIGHING MORE THAN 1900 GRAMS.		
54 (7)	Knight.	Mechanician.	1984
66 (8)	Abercrombie.	General.	1922
75 (8)	Benj. F. Butler.	General.	1922

WEIGHING MORE THAN 2000 GRAMS.

Age.	*Name.*	*Occupation.*	*Weight.*
65 (9)	Turgenieff.	Russian novelist.	2012

These are not selected cases, as they are all the recorded brain weights of eminent men which I have so far found, most of which I have taken from Bastian's and Donaldson's tables. If we divide the sum total of the brain weights in the preceding table by the number of persons represented, we find it gives a per capita average for eminent men of more than 1479 gm., which, when compared with the following table, is seen to be considerably higher than the average of the general population of any country.

TABLE OF AVERAGE BRAIN WEIGHTS.

(Havelocque and Harve.) (10)

Nationality.	*Av. Weight.*	*No. of Cases.*
Scotch.	1417	157
Bavarian.	1375	460
French.	1359	167
Italian.	1358	244
Chinese.	1343	13
Negroes.	1331	141

Here we see that Scotland, which is noted for its high intellectual average, shows the highest average in brain weights. Thus it is evident that when other things are equal brain mass is in proportion

to intellectual status. But when we come to examine the brain weights of some imbeciles and obscure persons, it also becomes evident that the *other things* than mass are by far the more important. The following list comprises some of the cases which I have met with in the course of my reading.

LARGE BRAINS—COMMON PERSONS.

Observer.	*Subject.*	*Weight.*
Rustan (11).	Mulatto.	1861
Wagner (12).	Woman.	1872
Oberstiner (13).	Workman.	2028
Wilson (14).	Carpenter.	2048
Morris (15).	Bricklayer.	2077
Middlemas (16).	Dement.	2096
Grant (17).	Workman.	2164
Rustan (18).	Laborer.	2222
Hevinge (19).	Imbecile.	2256
Army Med. Museum, Washington, D. C.	Squaw.	2278
Rudolphi (20).	Laborer.	2356

Little or nothing has been reported about the mental and moral characters of most of these cases. Dr. G. K. Wilson of the Morningside Asylum, Edinburgh, has made a study of the fourth case in the preceding list, and which demonstrates that a brain of very large size is not incompatible with an ordinary character and even long life. The subject died

at 75 years of age, was 5 feet 10 inches tall, and weighed 172 pounds. Dr. Wilson describes him as follows: "He was a sawyer all his life until a few years ago. His education was poor, but his intelligence seems to have been above the level required for his work. He was a good judge of wood and a fair amateur cabinetmaker. He lacked ambition, however, and was neither original nor very energetic. He had almost no interest beyond his work and family. He took no part in social questions, politics, or religion. He read very little, and did not care for amusements. He had a hasty temper and was given to bouts of drinking at one time; otherwise he was a good husband and father, and was very kind-hearted. The mental disturbance for which he was sent to the asylum was of the nature of a premature senile breakdown with marked confusion, aphasia, and impulsive violence" (14).

While the cause of the size of his brain may not have been, strictly speaking, pathological, the cause of functional inefficiency may have been psychic or moral by virtue of fettering factors in his early environment. He lacked incentive, perhaps, also to some extent, and while yet in the molding and seasoning stage he may have lacked the opportuni-

ties best fitting to his brain capabilities, for it seems he was mentally above his social level. It sometimes appears that children are made idiotic simply through their environment. Dr. James Morris reported a bricklayer, robust and 5 feet 9 inches tall, who could neither read nor write, but was fond of politics and not very sober. He had a good memory and a well-proportioned brain weighing 2077 gm. (21)

In comparing Europeans with the other races of the world, as in the following table, it again appears that the mean average brain weight is highest in the most intellectual or civilized, while in the table following that one, and containing the scattered groups, it will be noticed that the average weight of the brain of the ancient Briton, as indicated by the capacities of 56 skulls, is no less than 1460 gm., which is higher than the highest of any living race as yet reported.

AVERAGE BRAIN WEIGHTS OF DIFFERENT RACES.

From the tables of Dr. J. B. Davis, F.R.S. (24)

MALES.

	No. of Cases.	*Mean Average.*	*Average of Heaviest.*	*Average of Lightest.*
European.	299	1340 gm.	1364	1212
Oceanic.	210	1293 "	1369	1192

MALES—CONTINUED.

	No. of Cases.	*Mean Average.*	*Average of Heaviest.*	*Average of Lightest.*
American.	52	1282 gm.	1338	1209
Asiatic.	124	1278 "	1397	1155
African.	53	1268 "	1306	1165
Australian.	24	1190 "	1413	1027
		FEMALES.		
European.	94	1180 gm.	1278	1099
Oceanic.	95	1185 "	1239	1139
American.	31	1164 "	1263	1087
Asiatic.	86	1171 "	1276	1042
African.	60	1187 "	1220	1100
Australian.	11	1089 "	1194	966

SOME SMALLER GROUPS.

(Same authority.)

AVERAGE OF MALES.

	Cases.	*Average.*	*Average of Heaviest.*
Malays.	6	1393 gm.	1500 gm.
Javans.	30	1312 "	1517 "
Madurans.	10	1415 "	1569 "
Kanakas.	67	1330 "	1545 "
Australians.	17	1174 "	1482 "
Arancarians.	5	1371 "	1638 "
Esquimaux. (Greenland.)	5	1369 "	1604 "
Kafirs.	7	1363 "	1482 "
Negroes.	12	1230 "	1500 "
Dahomans.	9	1296 "	1397 "
Hindoos.	35	1228 "	1431 "
Mussulman.	14	1241 "	1466 "
Chinese.	25	1330 "	1585 "
Ancient Britons.	56	1460 "	1585 "

"In 1886," says Dr. Joseph Simms, "we measured many of the skulls unearthed at Pompeii, the remains of Romans who lived nearly two thousand years ago, and we found them on an average larger in every way, but especially in the forehead, than the skulls of Romans of this century." He found the same to be case with the skulls of the ancient lake-dwellers in Switzerland, compared with the skulls of modern Swiss. In the catacombs of Paris he found the skulls to average nearly an inch more in circumference than the skulls of modern Parisians (22). Such data are not very healthy for the delusional idea of evolution, while they strongly point to a modern degeneracy.

Dr. Gaston Le Bon has pointed out that the differences in the average capacities of the largest and smallest skulls of a race varies directly with the relative intellectual rank of the race. He finds these differences to be in modern Germans 40 cubic inches; in Australians 20 cubic inches, and among gorillas 12 cubic inches (23). Thus the highest and lowest possibilities are proportional to the intellectual level of a race or species; or, in other words, the lowest possibility is in proportion to the highest possibility. Monstrosities, idiots, lunatics, epilep-

tics, etc., are said to be comparatively rare beyond the borders of civilization.

When we compare the brain weights of the lower animals with that of man we find that while some animals, such as the canary, greenfinch, and some of the smaller apes (sajou and saimiri), possess a relatively heavier brain than man, other animals (as the whale and elephant) possess brains which are absolutely heavier. In fact, it can only be said that man surpasses all other animals in the proportional development of his cerebral hemispheres, and in their complexity. The psychic correlatives and causes operating in brain weight and form can only be arrived at by a thorough comparison of those features with the habits and characteristics of men and the lower animals, which as yet have been very imperfectly studied.

If we glance at the brain weights of the lower animals, we will observe that they bear no fixed relationship to any one psychic quality or combination of such qualities, in so far as these animals are known. From the works of Bischoff and Chauvau on comparative anatomy I take the following figures (in grams) of the brain weights in average-sized animals: Elephant, 4960–3968; whale, 2248–1984;

horse, 680–600; ox, 500–400; gorilla, 500–400; orang and chimpanzee, 400–350; ass, 360; tiger, 291; lion, 250–200; dog, 180; pig, 160; sheep and goat, 130; cat, 30.

Nor does brain weight bear any regular relationship to body weight, as will be seen from the following figures of comparative weights of brain to body, taken from the same authorities: Sajou (monkey), 1–13; canary and greenfinch, 1–14; saimiri (monkeys) 1-24; rat, 1-31; mole, 1-36; man, 1-35-37; lemur, 1-42; lizards, 1-160; eagle, 1-160; carp, 1-248; dog, 1-250; bear, 1-265; hen, 1-347; elephant, 1-500; horse, 1-700-400; ox, 1-1000-800; ostrich, 1-1200; shark, 1-2496; land turtle, 1-2240; whale, 1-3300; sea turtle, 1-5680.

CHAPTER VII.

NORMAL MIND.

By the term normal mind I mean the prompt and coordinate action of all the mental faculties coexisting with pacific disposition or temper. It has no reference to knowledge in the numerical sense, nor capacity in the geometrical sense, but simply that state of mind which enables the individual to do his best in any given relation.

GENERAL ASPECT.

Of ten business or professional men selected at random, at least eight would commonly be regarded as normal in the sense of being representative of the community standard of free agency. But these eight will differ one from another to such an extent that each may meet his opposite in views and disposition in one way or another, and yet the faculties of feeling, reason and will may be regarded in all as in good working order. Between the com-

mon types of different races and nations the same condition exists, a condition which, barring the difference of language, precludes harmonious action on any question of common interest, without a wasteful expenditure of both time and energy. This is evidence that the common normal is not the complete, and that feeling, reason and will are somehow defective. But as there is naturally no essential difference between man and man viewed from both psychologic and physiologic standpoints, this difference must be due to difference in ideas and habits, and as every act not naturally instinctive is originally the product of an idea, the question of cause is resolved into: What ideas conduce to the really normal mind or approximately perfect?

When we consider the nature of ideas, it is evident they are not only true or false, but vary in importance or value as measured by their utility as means to an end—the scope of their application to final purpose, whatever that may be. Ideas of purpose being both the product of elaboration and motive to acts are either conservative of energy, or have an opposite effect, directly or indirectly. But as tone of brain is the equivalent of tone of mind, owing to mutual dependence, it is evident that a

false purpose will induce a dissipation of energy which will reduce the intellectual range by its enfeebling effect. Thus the question arises: What ideas of final purpose are in harmony with nature that we may live to the best advantage—be serene in mind—coordinate with natural or necessary environment. To this end we might take the characters of great men who have been universally loved and respected, and find their actuating principles, which have done far more for our well-being than have pills and powders. We would find, on careful analysis, that the dispositions of egotism, malice and fear were seldom if ever manifested, as they rarely existed. All mental reactions depend upon the principles, the experience and the habits of thought of the individual and purpose in life, which in some extend no farther than self-preservation.

EVOLUTION OF CHARACTER.

When we consider mind as an entity, the question of its environment begins at the germinal stage of life—the relationship of the chromatic elements to the differentiating entity of the protoplasmic nidus or environment, and which entity is finally manifested as mind. Excluding maternal accidents,

the formative forces prevail under prenatal laws with the minima of impediments. At birth, the new environment with its stimuli to the senses, gives mental motions to a potential basis which is gradually cradled, so to speak, into manifest consciousness. The cosmic conditions, as ever present factors in the molding of the infant mind, pave the way for the apprehension of those great and everlasting impressions or intuitions which later dawn upon the reason and stir the powers to greater action. Thus that eternal monitor, the conscience, is evolved alike in all human beings. Though as unalterable as the fixed laws of nature, of which it is the exclusive product, conscience may be perverted or clouded by criminal career or criminal influence—crimes against truth, justice and economy. For the same reason that conscience is a fixed quality—the product of the fixed laws or operations of nature, and therefore of necessary experience—the inherent disposition against all aberrant conditions, physical and mental, is to assume the normal, a result that will always ensue if the evils of inherited bent and environment are not too strong for the healthy remnant. Otherwise "the weakest must go to the wall"—the wall of dissolution.

In the infant, mind is in its most plastic stage, the earliest impressions and habits being the most lasting and forming the basis for future disposition. As the evil habits and conditions which contributed to its protoplasmic impress, or hereditary defect, may still rule the nursery, it is evident that mental restriction must follow with conscience crowded out of notice, or pointing in vain. Heredity, as the cumulative effect of all experiences cosmic, racial and ancestral, must necessarily give the child a bearing toward its external environment (transsomatic) which will vary with the differences of transmitted impress, and consequently inclination and intuition will have different bents. Indeed, so powerful is transmitted bent that not uncommonly a child of criminal ancestry, though for a time systematically educated under good influences, will revert to the criminal class, just as sometimes the young Indian from college does to his racial habits. Of course, the civilizing influences have only been *conforming* in effect, *not reforming*. Such disposition is due to the irksomeness of inaptness, a sort of intuitive leaning having a potential or instinctive basis. Thus, by early training, the normal intuitions of the mind may be displaced by purely selfish

ideas and criminal character be formed, such as the character of the burglar or the political or commercial knave. It is such cases that must be "born anew"—radically changed in views—before they can be brought in harmony with natural economy—with the great final purpose in nature, which can only be correctly apprehended, even in part, by the normal mind—the fully free.

The stage of infancy is ruled by instinct and intuition almost entirely in the acquisitive form. At first ideas associated by suggestion gradually dispose the mind to analysis, then synthesis, with the faculties of recollection, judgment and reason slowly evolved in due order. The experiences of all children, naturally treated, are essentially the same, so that when they arrive at the age of reason, instinct and intuition lose their official importance and questions of conservative interest arise for rational consideration. Later on the question of final purpose dawns upon the youthful mind, and though it cannot be logically solved by it, experiences and intuitions have given sufficient assurance that certain things are right until intelligence makes duty and purpose more definite and distinct. Here, I may observe that the child of the country—of

pastoral surroundings—being freer from artificial distraction than the child of a metropolis, is more profoundly imbued with the results of cosmic impressions, and thus later in life is more likely to acquire prophetic insight. Thus the untutored mind of the peasant, as illustrated in the "Cottar's Saturday Night," may evince great wisdom and peace because of living in line with a final purpose in harmony with intuition and *common sense.*

STATES OF MIND.

Self-control, in harmony with first principles or the self-evident truths in nature, is the essential characteristic of the normal mind. It is the condition of the greatest freedom of the will and power of attention with which it is commensurate. The power of discernment and the power of choice are at their highest degrees, and are at all times ruled by truth, justice and economy. Full self-possession contains no egotism, malice, or fear, for it is the necessary product of logical living. The great and self-evident fact that the highest good to self is dependent on the attainment of the same by others is an ever present thought as a dictate of conscience. One of the first great impressions which naturally

comes to the human mind after the sense of freedom, is the sense of absolute dependence—the law of gravitation, so to speak, in the psychologic world. Following this, the fact of inherited environment with its many and varied misfortunes, whether of wealth or poverty, gives basis to charity, which, when logically exercised, works for harmony and efficiency along all progressive lines. Thus we gather guiding principles which with growing knowledge lead to a fuller recognition of our relationship to time, eternity, and an Infinite Personality, and while we perceive our high dignity in natural economy, we carry the conviction of absolute dependence. Witness the modesty, the magnanimity and the self-sacrifice of true greatness.

But these great and guiding principles which work for harmony and progress may be stifled in their birth by the inculcation of morbid or false teaching and example, and thus the selfish character develop with egotism, malice and fear as necessary conditions.

A typical case of undiluted selfish character came under my notice in the New York City Workhouse. He was a man about 30 years of age, and by profession a bank burglar. He had served several

terms in the penitentiary, but was committed to the workhouse for one year on a minor offense. As prisoners were allowed more liberty during their last month's service, I engaged him to shave me (I was then acting-surgeon to the prison) in my room, that I might have the opportunity of finding the roots of his character. He was an unusually "nice looking," shapely and clever fellow, facts that seemed incompatible with his history of early and continued crime. After discussing all sorts of questions with him at different times, the fact was revealed that he firmly held the belief there was no future state, and that it was reasonable to get everything *now*, no matter about the rights of others who possessed whatever he wanted. Thus his niceness was simply habit or policy.

Egotism, as the "I am more than I am," is quite a different thing from the positiveness of decision, the assertion of a truth, or heroic action. It is an exhibition of personal importance with disrespect for others without just cause, and arises from a selfish disposition to be esteemed more than our merit, with a delusional basis. It is very common and conspicuous among the insane and is essentially an abnormal product.

Malice, as the disposition to injure others purely for the sake of inflicting pain or antagonism, or in some cowardly indirect method of "getting even," is quite a different thing from correction for a wrong, which, though it may be ineffectual, is curative in its tendency. It springs directly from selfishness as an attitude for its own protection along chosen lines, and with no disposition to apologetic considerations. It has the same delusional basis as egotism, viz., lack of the sense of dependence.

Fear is the product of uncertainty—a necessary condition of selfishness, and comes from the obscurity which necessarily more or less exists in all abnormal states of mind and acts therefrom, whether of guilt or disease. To live in the light of fundamental principles (common sense) is to have such a telescopic view of life that consistent action can bring no fears. Not to so live is to live in shade or obscurity, so that acts must carry with them more or less uncertainty of result, and fears arise. The innocent, in view of the final result in the light of final purpose, can have no fears. The fear of childhood is the fear of imperfect understanding and is as transient as the cause. Fear from guilty acts is the fear of conscious desert of punishment

and has reference to unknown remote results with indefinite persistence.

Grief, as the effect of unavoidable or unintentional evils or social loss which cannot be replaced, has a disturbing action on the mind because of the element of uncertainty of result or personal responsibility, and is therefore a form or degree of anxiety. It is frequently associated with personal misgivings of our own real or fancied delinquency in relation to the object, and is thereby mingled with fear.

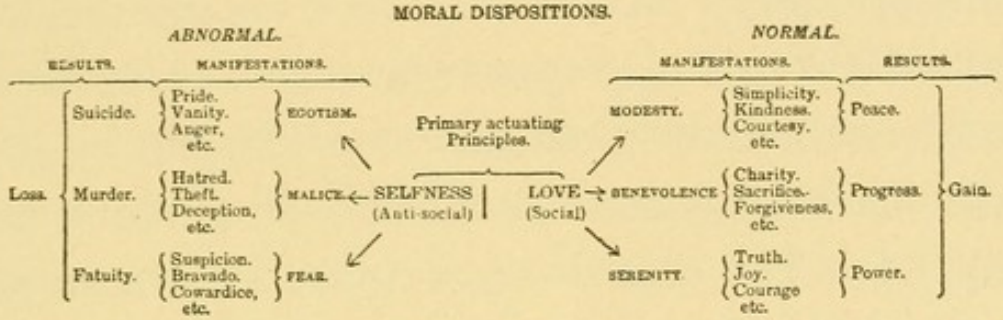
Anger, like fear, works to the disadvantage of the subject, and consequently is not a normal state of mind. It is precluded by a clear and full view of the whole situation and its relations, with complete self-possession — conditions depending on a full acting brain. Anger is a *product* of all abnormal dispositions of mind and brain, though not always manifested, and while in its nature it is a symptom of imperfection, it is the least aberrant of all abnormal dispositions of the mind. It is simply a disturbance of temper or co-ordinate mental action. Complete immunity from it would imply absolute perfection—a somatic impossibility. It must be distinguished from active self-protection.

Love is the outflow of the sense or realization of mutual dependence, mutual need of reciprocity. It is therefore the normal product of instinct, intuition and reason, and thus it may have many forms, according to whether instinct, intuition or reason predominate in serving the cause. Love begotten of intuition is the most intense, that of reason is the most lasting. It is the assurance of harmony and coördination with nature and is the root of all conservation of energy in the line of true advance. It is the sacrifice of present personal desires which are in conflict with natural economy.

Sociability.—Man normally has a social disposition which in childhood is general or promiscuous, just as talents carry with them a desire for their use. As years increase this disposition becomes more and more select for specific purpose of mutual advantage and for that purpose systematic exclusiveness is required for the attainment of a particular end, otherwise there would be dissipation of energy. Thus, while sociability is normally a product of love, it can be claimed only by the fitness of means to an end and therefore an exclusiveness may result, manifested as an eccentricity. Difference in habits from the conventional (eccentricity)

due to exclusiveness for a rational purpose indicates intensity of character above the common, but otherwise eccentricity is a symptom of the delusional state (disease).

MORAL DISPOSITIONS.



NOTES.—(1) Few, if any, individuals are exclusively the one or the other, but usually vacillate between the two principles owing to weakness. The one may wear the appearance of the other and thus have failure or success accordingly, viewed from the standpoint of fundamental principles.

(2) By *suicide* I mean either a violent or slow process of self destruction. By *murder* I mean either a violent or slow process of destruction to others. By *fatuity* I mean that state of mind which has such a mixture of both these dispositions that more stupor than impulse results.

THE FACULTIES.

By reason, feeling and will we commonly include all of mental action. The one cannot exist without the other, but they embrace distinctive modes of mental process, as seen in the accompanying analytic table (page 129).

The *acquisitive faculty* is the power the mind has of receiving impressions through the organs of the body and translating them into ideas. So keen can this power become in special lines, vision for example, that disciplined observers can accurately note hundreds of objects in a room by a glance on pass-

ing its door and afterward describe every detail which was within view. In my own experience in early student days, I acquired the faculty of reading a whole line at a glance, or about as quickly as I now ordinarily do a word. That the mind is also constantly receiving impressions which are not consciously perceived at the time is evidenced by somnambulistic feats and the doings of persons preoccupied. The case of an ordinary female servant who in the delirium of fever repeated whole passages of Greek and Hebrew which had been recited within her hearing years before, and which she neither understood nor gave attention to at the time of hearing them, goes to show the imperishability of mental acquisitions and the vast amount acquired unconsciously.

The *conservative faculty*, or the power of holding impressions or ideas subconsciously for future use, preserves all experiences and thoughts, classified according to one relationship or another, and therefore made more or less available for use when needed, according habits of associating ideas.

The *representative faculty* is commonly known as memory, but is properly the power of the mind to reproduce ideas from memory. It is either volun-

tary or involuntary, but in man usually both, and in the purely voluntary form it appears to be exclusively a human faculty. Voluntary reproduction, strictly speaking, is a process of exclusion in favor of certain lines of association or groups of ideas. This faculty habitually exercised can perform wonders compared to the degree in which it commonly exists. Indeed, some persons can instantly recall almost any forgotten experiences. When a lad of 16 years at Edinburgh, wading through the ponderous tomes of Turner and Liebig's chemistry, I systematically tested my recollection after four or five hours' consecutive study, covering forty to fifty pages of new matter, and found that at times I could not only recall many of the ideas, but also the page and setting containing them in pictorial representation. This faculty improved by practicing the careful retracing of thoughts by sequence. The faculties of perception and recollection show what a mass of mental material exists subconsciously, only to be brought in view when the mind is fully emancipated from somatic conditions (perversions). Later on, when a student in London, I practiced as an experiment for a number of weeks the habit of daily reviewing my experiences in minute detail,

beginning with the last sensation or thought. Between 5 and 6 p. m. I would comfortably recline upon a sofa and close my eyes. At first the task required considerable effort to connect all the perceptions of a day, but I soon acquired the power of reviewing the experiences (subconscious perceptions) of many months within a space of time less than an hour. I found that by *directing* my attention to a given point and then holding it *passively*, ideas would instantly cluster about the central one by the natural law of association—suggestion. I would have a pictorial representation in natural order and seemed to again experience something of the original feelings that accompanied them. The review seemed complete, although some fields of experience required more effort than others to complete them. But the most remarkable revelation was the rapidity with which I sometimes could cover a large territory—many thousands of perceptions—within a few moments. It was mostly by *suggestion* and only partly by *recollection*. The faculty of *recollection*, depending as it does upon a conventional system or predetermined line of association of ideas by the individual, is one of the latest developed and highest faculties of the intellect, so that

when degenerative changes of the brain take place, it is one of the first to weaken.

The *elaborative faculty* is the power of the mind to relate things according to purpose or plan. Its highest form is *reason*, which calls in service every mental process. Reason is chiefly dependent on the faculty of recollection—the faculty of recalling anything *wished* through a system preëstablished by the individual. This enables reason to advance beyond intuition and also produce certainty for surmise. Reason pure and simple is the last and most complex faculty evolved, and as the creature of self-discipline it is the first faculty to weaken in most brain degenerations. This is why fixed delusions usually appear long before the simpler faculties show any marked enfeeblement. I doubt if reason, strictly speaking, is possessed by any other creature than man.

The *regulative faculty* is the presidential power of the intellect, but with no more power of action than is delegated by its constituents, the subsidiary faculties. Its strength of action (the will) depends upon the relative efficiency of all the mental faculties governed by fundamental or first principles discerned by intuition and reason from necessary or

universal experiences and known as *common sense* (not common notions). They are the principles that work for harmony and progress.

Instinct is the expression of elaborative efforts of organization and parts for conservative ends. There are three principal forms: 1. Cosmical instinct, or the instinct of *first acts*, such as the sucking of the babe, or the pecking of chicks—for the *preservation of the individual.* 2. The instinct of *sexual attraction*—for the *preservation of the species.* 3. The instinct of *preponderating talent*, or the desire to exercise an inherited power—to the *advantage of the species* for final purpose. As a propensity, instinct is the first manifestation of subconscious elaborative action, which is a necessary condition of growth and experience.

Intuition is also a subconscious action of the mind, but bearing a *concept* as a product, instead of a *propensity.* It is a faculty common to all the higher animals and is often mistaken for reason in them. It is the power of the natural or poetic mind as distinguished from the *logical.* If the state of the mind is normal and the related subconscious data are correct, intuition must be accurate when pronounced. Such a condition is only approxi-

mately attainable. But our great motive ideas are mostly intuitional, more or less, as few minds can consciously calculate to a conclusion with all the data involved even in everyday problems. Women, who commonly live more *naturally* than men, possess it in a higher degree, and in those who are well informed and conditioned, it is more reliable than the exercise of reason in the imperfect form so common.

Attention.—The power of attention is the power of the will and is the first condition required for the appreciation of an object by the perceptive faculties. If it equals the measure of scrutiny and if the measure of scrutiny equals the nature and number of ideas engaged and the order in which we bring them to bear on the object, together with the manner in which the object is exhibited, then the impression or notion received of the object will accord with the measure of attention given it. In mental fault the attention is weakened and the subject is more or less passive, as in infancy, so that perception is incomplete. Attention is given more to the *pro* side than the *con* side of the thing presented or the quality suggested, and if the favoring circumstances remain undiminished, complete sub-

jection (hypnotism) will result. Arrest of attention is palsy of the will, which is subjectivity of the mind.

Emotion is a normal condition, but in its manifestation is inversely proportional to intellectual range. It is the product of suggestion on subconscious factors in the mind in accord with the law of the association of ideas. In normal mind it can be controlled by the power of the will to exclude or substitute ideas as directed. Emotion is most profound in the intellectual but least manifest as there is less physiologic excitement, because of greater self-possession which is equivalent to a higher tone of the nervous system. It is most manifest in those who have a *poetic* habit of mind rather than a *scientific*—systematic or logical, and thus they are more or less subjective to external direction. The subjective state of mind is equivalent to passive attention or the taking cognizance of nothing but evidence supporting the idea suggested, and thus hypnotism or mesmerism may be induced by an exclusive direction of attention instituted by a second person. Voluntary exclusive direction of attention to a *negative* object will induce auto-hypnotism. Ordinary manifested emotion is largely an expression of confusion and weakness. No one can be

hypnotized without submitting (consciously or unconsciously) and many cannot resist. It is this rendering an audience subjective, or gaining passive attention by *direction* or control, that is the secret of the orator's success. Emotion (feeling) is largely the product of the actual state of the bodily organs which are more or less influenced by thought. Pain

SYNOPTIC ANALYSIS OF THE COGNITIVE FACULTIES.

ACQUISITIVE.
(*Perception.*)

Internal Perception. Consciousness of Self through contrast with externals in translation—Perception proper.

External Perception. Consciousness of externals through their effect on the senses—Sensation

CONSERVATIVE.
(*Memory.*)

Sub-conscious ideational coherence by the law of Association operating in inverse ratio to the time, space and causal distance between things (ideas). It is the "heart" or storehouse of the intellect.

REPRESENTATIVE.
(*Imagination.*)

Suggestion. The involuntary return of ideas to consciousness through natural or association affinity. (Common to all animals).

Recollection. The voluntary reproduction of ideas to consciousness according to individual habit or system. (Exclusively human.)

ELABORATIVE.
(*Relational.*)

Analysis. Separation by affinities or qualities or structural relation.

Synthesis. Conjoining by affinities or qualities or structural relation.

Judgment. Affirming a similarity or dissimilarity between two things.

Reason. The comparison of two things with each other through a third.

Intuition. The sub-conscious action of the mind in a new and conscious relation bearing a concept.

Instinct. The inherent faculty of lower and undeveloped organizations operating in lieu of reason or experience for conservative ends.

REGULATIVE.
(*Reason and Will.*)

Common sense—a priori or First Principles—the product of necessary or common experience—in action with new relations.

NOTES.—(1) A mental faculty is an inter-dependent mode of activity.
(2) *Active* Attention or the power of voluntary direction and exclusion is a measure of the freedom or power of the Will; the Will is dependent on Reason and Reason on the efficiency of the subsidiary faculties.
(3) The mind being ever active is always in a new relation.
(4) Instinct is the first manifestation of mind, Intuition the later, and Reason the last or highest.

or misery, like hunger, is the expression of a need, and the feeling of well-being is the expression of satisfied claims for physiologic requirements. Perversions of different organs have different effects or suggestions on the mind by their sensory influence. The different mental effects of drugs is thus

probably due to their action on one or other of the various vegetative organs by the selective affinities of their different cell elements which each possess, rather than to any direct action on the brain.

NORMAL DECADENCE.

Dotage or second childhood is commonly regarded as a normal terminal of old age. But as over all other organs the brain is much the least affected by general waste or starvation, it would appear that the mind should retain its powers much beyond those of the bodily frame. As indicating the normal disposition of the mind in advanced age to recur to early experiences I present the following extracts from letters of distinguished persons who up to the date of writing were actively employed in one way or another.

From Mrs. Elizabeth Cady Stanton, now over 80 years of age, and at present preparing her reminiscences, I glean the fact that her mind is strong and active with a vivid memory. She says: "I love to think over the joys and sorrows of my childhood and girlhood, and to see myself in pictures as I looked then." She thinks "there is an immense advantage in doing this, as it makes us more sym-

pathetic with the young, more tender with their trials, and more desirous to make them happy. I would fain save childhood from suffering what I did from restrictions." But her opinion is that "with a vivid, keen memory, all persons must more or less dwell in the past. Those who retain an active interest in the questions and reforms of their day, would, on the other hand, be more occupied with the living present."

Miss Frances Willard, 56 years of age, President of the National W. C. T. U., says: "I have observed for some time past that I was growing inclined to think of that which had been of especial interest to me in my childhood and youth. The same tendency was clearly manifested in my dear mother who was with me until the 88th year of her age, and who retained every faculty until the end. So far as my observation goes, this tendency is strongly marked in all people who are known to me. The more years, the more backward looking over, though they may be profoundly interested in and preoccupied by current affairs."

The Hon. Joseph Medill, editor Chicago Tribune and President of the Chicago Press Club, 73 years of age, says: "I can discover no further change in

the action of my mind than can be accounted for by experience, further study on many topics, and wider observation of men and things. The most marked change is that memory of the more recent occurrences seems weaker, less accurate, especially in dates, names and sequences of events. My mind recurs to youthful events and dwells on pleasurable or painful matters which then took place, the memory being quite vivid and accurate of things which happened in my teens or the first decade thereafter. I believe this is the experience of most elderly persons. My judgment or reasoning powers do not seem to be impaired with advancing years, though I cannot think or conclude as rapidly as in past years, but consume more time in arriving at fixed conclusions."

Ex-Governor Oglesby, thrice governor of Illinois, now 72 years of age, writes me: "I cannot say that my mind recurs more frequently to early experiences in advancing age than it did formerly in younger years. As a matter of fact I have always delighted in reflection upon and remembrances of my childhood days. I suppose this is quite common with all rational beings."

From N. S. Davis, M.D., LL.D., Emeritus Pro-

fessor of Medicine, Northwestern University, and ex-president and founder of the American Medical Association, 82 years of age: "There is clearly in my own mind a distinct tendency to revert back to principles, facts and therapeutic applications of the earlier years of professional life. Certain it is that early impressions are far more durable than those made from 60 years onward to the end of life. I think this is easily traced in all educated and mentally active people."

It is thus evident that the normal dispositions of the mind in advanced age are retrospective and contemplative. Early experiences are the more profound and enduring in their influences on life as "the child is father to the man," and they sink to obscurity by the calls of an ever changing environment of necessity and ambition, until, finally, the pinnacle of experience is reached and historic contemplation begins. The acquisitive faculty wanes with the decline of the sensory and motor powers, and things of recent date become less impressive. Thus, the disposition to retrospection is born of the growing retirement from the daily cares of active combat, and the punctuation points of early life, which lie at the basis of all character, press forward

for the consideration of the wisdom that comes with maturity of decadence as a blessing to rising generations. But the process of degeneration, as differing from normal decadence, must play a part, though ever so slight, for it is not to be presumed that heredity and environment will leave any individual untainted with the effects of their evils. Also, the highest type of the individual, through strain of ambition, may forget the inexorable exactions of nature and thus trespass the conservative limits.

It thus would seem that dotage is not a normal or necessary condition of old age, but a product of degeneration as differing from normal or natural decline. At last the brain, as the servile mechanism of the mind, fails to furnish the degree of energy requisite for co-operative labor, time and space cease to be factors in the evolution of the individual, and the veil of mystery—the occasion of all effort—remains as ever, to solicit the attention of the living and spur the strong to thought and conquest.

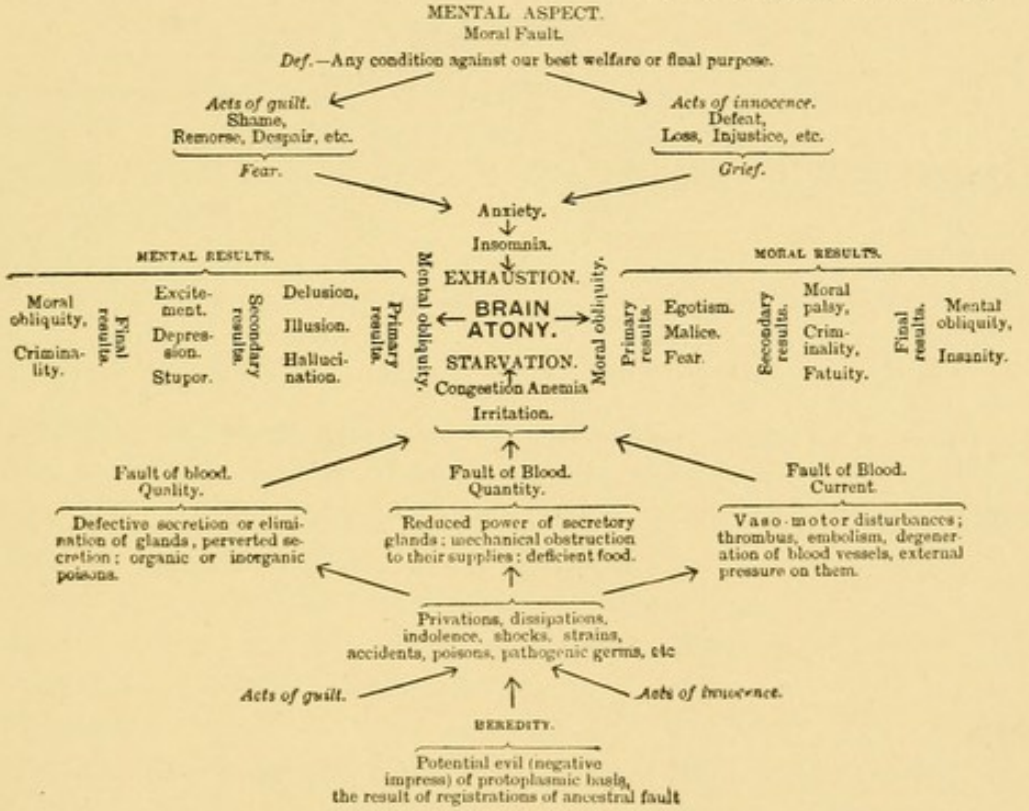
In conclusion I may observe that for the same reason that matter is indestructible, mind is immortal, and because similar results can only follow similar conditions, character cannot change *post-*

mortem in any way possible *ante-mortem*, so that the exit from this life must fit an entrance of the next. Thus the mind most subjective to First Principles will gain most in time and eternity.

THE PHILOSOPHY OF DEGENERATION.

OR CAUSATIONAL ANALYSIS OF MIND FAULT.

Premise.—The power of Discernment with the power of Choice implies commensurate personal responsibility, therefore degradation has primarily a *moral* cause and finally a *mental* result, or reduced capacity for enjoyment. (Free functioning.)



NOTES.—(1) Brain atony is any condition of brain which does not successfully react to normal mental demands, and is relative to individual capacity.

(2) Causes and effects operate in a circle and run parallel to each other.

(3) Insomnia is deficiency of brain *rest* in any degree.

(4) By degeneracy I simply mean disease, and not atavism, a theory which some evolutionists hold.

(5) By Insanity I mean a defect of reason, a delusional state of mind fixed against reason or evidence.

(6) By criminality I mean a defect of feeling or conscience; first principles are unrecognized; truth, justice and economy are totally disregarded when in conflict with desire; no grief follows wrong doing; the intellect is clear, but normal sentiments of relationship are absent or inoperative.

(7) Moral palsy or paresis is a defect of will, and implies the possession of normal sentiments with abnormal habits—a succumbing to temptations—a defect of self control in one or more ways; grief follows wrong-doing; no delusion exists fixed against reason. As each condition tends to beget the other, all degrees and combinations are found. Moral paresis in one form or another is almost universal.

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DEFINITIONS.

Axon—A term used in place of neuron when neuron is used to signify the cell and its parts as a complete anatomical unit.

Anthropoid—Man-like.

Ambiguous—Difficult to classify.

Assymetrical—Not in proportion with its opposite side or half.

Atrophy—Wasting from lack of nourishment.

Axiom—A self-evident truth.

Capsule—A membranous covering or sack.

Calcified—Lined o ermeated with lime salts, usually from rheumatism

Cerebrum—The upper and larger hemispheres of the brain and known as the *fore-brain* in lower animals.

Cerebellum—The under and smaller hemispheres of the brain and constituting part of the *hind-brain* in lower animals

Congenital—Existing from birth.

Convolutions—Rounded projections formed by depressions or fissures.

Correlative—Working in harmony with.

Delusion—A false idea, the result of defective reasoning or the improper association of ideas.

Dendron—A tree-like figure.

Entity—A species or thing special in its origin and character.

Fissure—A narrow cleft or separation.

Function—The purpose of an organ or part.

Fusiform—Resembling a spindle.

gm.—Gram—15.434 grains troy.

Ganglia—Bundles of cells.

Gyri—Convolutions.

Glia—A bindweb cell—web-like substance of the brain—neuroglia.

Hallucination—A suggestion or imagination originating from a disturbance in some part of a sensory organ.

Histologic—Relating to the minute structure of tissues.
Homogeneous—The same composition throughout.
Homologous—Similar in function, but differing in form.
Illusion—A wrong perception of an object.
Lesion—An injury or abnormal change.
Motor—Having to do with motion.
Molecule—The minutest particle of a substance.
Metabolism—The natural chemistry or necessary changes in living tissues—supply and demand operating in the cell.
Menstruation—A periodical and natural condition of sexual disturbance in females.
Microcephalic—Small head, weighing less than 1000 grams.
Micro-organism—A germ visible only through the microscope.
mm.—Millimetre, $\frac{1}{1000}$ metre = $\frac{1}{26}$ inch.
μ=.001 mm.
Neuron—A nerve fibre, sometimes used to mean the nerve cell with all its off-shoots.
Nucleus—A cell within a cell, its vital center.
Nucleolus—A cell within a nucleus.
Neural—Pertaining to a nerve or nerves.
Neuroglia—Pertaining to the web-like substance of the brain.
Pathologic—Relating to disease.
Pathology—Abnormal process—disease.
Polymorphic—Many shaped.
Pigmented—Containing coloring matter.
Physiognomy—Facial expression.
Pyramidal—Shape of a pyramid.
Psychic—Mental—pertaining to mind.
Reacting—Responding to conditions.
Sensory—Pertaining to sensation and sense organ impressions.
Somatic—Body or physical organism
Specific—A definite or fitting quality or quantity.
Stereotyped—Fixed or habitual.
Sulci—Grooves.
Toxic—Irritant—poisonous.
Vadum—A shallow in a fissure, representing a possible isthmus.
Vascular—Pertaining to tubes, blood-vessels.

SUPPLEMENT TO CHAPTER IV.

Cases of Brain Tumor with mental integrity reported by Dr. Byron Bramwell in *Brain*, Spring, 1899. The black areas on the figures indicate the location and surface extent of the tumors. The case numbers are the same as in Dr. Bramwell's article.

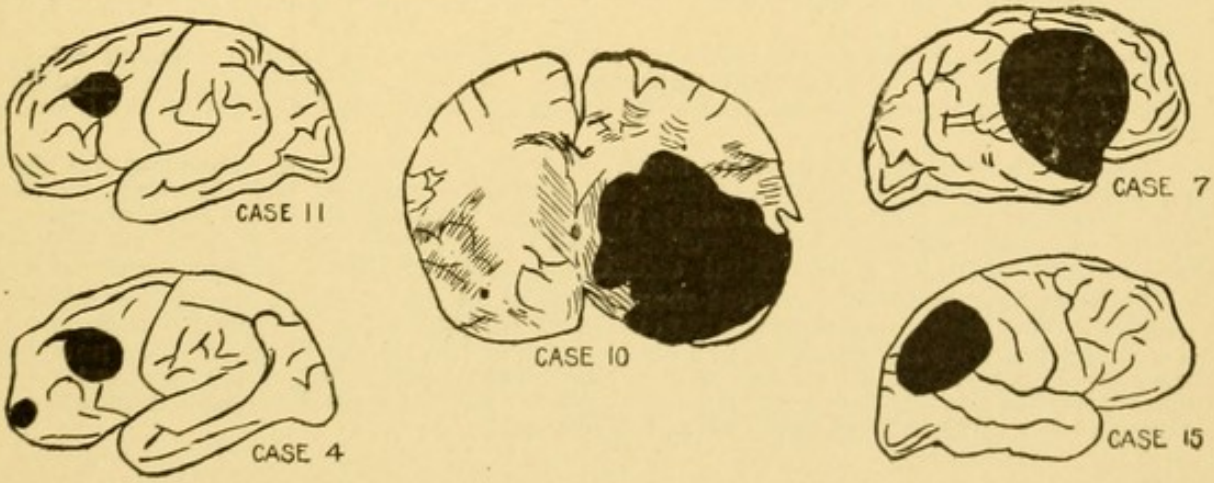
Case 4. Age 34, widow. Two sarcomatous tumors in the left frontal lobe. The posterior third of the second left frontal convolution (Exner's writing-speech center) was entirely destroyed and up to the time of the operation there were absolutely no mental symptoms and no agraphia (loss of power to write). Illustration shows cross section through the middle of the brain.

Case 7. Age 20, shop-girl. Sarcomatous tumor on the right side. The speech center and a very large portion of motor area were completely destroyed, yet there was absolutely no paralysis and no speech defect. No mental symptoms existed before operation except that the patient was much more quiet than she used to be.

Case 10. Age 32, laborer. Enormous gliomatous tumor involving and destroying the greater part of the left frontal and temporo-sphenoidal lobes and a large part of the left occipital lobe. No paralysis, no aphasia, no deafness, but marked mental impairment and, at times, psychical blindness.

Case 11. Age 63, excise officer. Cyst in right temporo-sphenoidal lobe and a tumor (glioma) the size of a large walnut in the posterior end of the second left frontal convolution. Absolutely no mental symptoms, no speech symptoms and no motor symptoms.

Case 15. Age 41, chemist. Nodulated tumor involving the right angular gyrus and the adjacent parts of the parietal and occipital lobes with extensive softening of the subjacent white matter. Mental impairment and loss of memory.



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