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F. W. MOTT

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WITH DIAGRAMS

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PREFACE

This little book is an amplification of three Chadwick Trust Lectures delivered last year. I feel that some apology is due to my readers, for I recognise that "Nature and Nurture in Mental Development" is a vast subject, embracing as it does physiology, pathology, psychology, biology, medical science, hygiene, pedagogy, and sociology. Consequently only a little ray of light can be thrown here and there in such a short course of lectures. It is, however, to be hoped that the book, if it serves no other useful purpose, may stimulate the reader to further inquiries regarding the respective parts played by environment and heredity in mental hygiene.

I have endeavoured to show that there is a correlation of mind and matter; and that the cerebral hemispheres, which attain so great a development in man as compared with the lower animals, is evidence thereof. This conclusion is supported by the fact that in idiots and imbeciles there is a failure of development of the microscopic cell and fibre architecture of the cerebrum

(great brain) proportional relatively to the failure of the higher functions of mind. Again, in loss of mind (dementia) there is a correspondence in the degree of destruction of cells and fibres and the loss of mind. The feeble-minded is born poor in the anatomical substratum of mind, the demented was born rich, but has become poor on account of disease. The race poisons, alcohol and syphilis, are the two great preventable causes of inborn and congenital feeble-mindedness in children and of loss of mind in adults.

From time immemorial it has been recognised that a healthy body is requisite for a healthy mind, but only within recent years has it been shown that there is a bio-chemical association and interrelation of all the organs of the body, and that subtile chemical substances are poured into the blood by the tissues and organs of the body, especially by the ductless glands and sexual glands. These internal secretions or hormones (ὁρμάω, I excite) play a very important part in the functional correlation of the two master tissues—viz. the brain, the principal organ for the preservation of the individual, and the sexual glands, the organ of preservation of the species. I have ventured to touch lightly upon the hormone theory in arousing the vague, unsatisfied desires in the mind which eventuate in a natural perceptual attraction for

the opposite sex, and the important part this natural physiological instinctive process plays in the development of the passions and sentiments. Suppression of the normal physiological processes of reproduction, and the maternal instinct of women, is one of the pressing problems of modern civilisation. The foundations of character are built upon the instincts, appetites, and desires connected with the preservation of the individual and the species, as was poetically expressed by Schiller in the lines :

> Durch Hunger und durch Liebe,
> Erhält sich die Weltgetriebe.

In these lectures I have given considerable attention to the Neuropathic Inheritance in Relation to Crime and Insanity, because this has been a subject in which I have been much interested for years past in my capacity as Pathologist to the London County Asylums. I am no believer in Lombroso's theory regarding the born criminal, and I have given reasons for my disbelief. A child may be born feeble-minded and with a lack of higher control, so that imitation and suggestion in later life may easily lead to criminal actions. Again, epileptics are subject to criminal impulsive acts and of automatisms of which they are subsequently unconscious. Disorder of mind—insanity—does not come on till after puberty, when a new vital force glows

in the sentiments and passions connected with the desires associated with the sexual instinct and ambitions for power and wealth. I have selected from a large number of pedigree charts, which I have collected, examples to show the neuropathic inheritance in its many forms. I have only incidentally touched upon the pedagogical side, and then only in so far as it relates to the physiological and psychological aspects of Mental Development. A distinction has been briefly drawn between the hereditary raw material of mentality and the social heritage slowly built up by man, of which the brain is the receptor and store-house. I have attempted to show that the finished product of education depends for its efficiency both upon a good mental and bodily raw material and opportunity of reaping the full advantages of the harvest of human thought and progress.

The medical inspection of school children and health visiting now plays such an important part in the development of body and mind that I thought it desirable to append a short account of this by one who is engaged in this practical work.

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NATURE AND NURTURE IN MENTAL DEVELOPMENT

The problem of nature and nurture in mental development is one that has recently acquired importance for various reasons, such as the increase of certified insanity and the enormous sums of money spent on asylums for housing lunatics. The recognition by the public that insanity, epilepsy, and feeble-mindedness are in great measure due to inheritance has led to a widespread feeling that some check should be placed upon propagation of the mentally unfit. This is becoming daily more manifest from two causes: The migration and emigration of the mentally and physically fit from the rural districts, and the sedimentation of the unfit in the slums of our large cities, where degraded pauperism exists to so great an extent.

The rapid growth of population in this country commenced with the growth of industrialism, and the rise of towns and cities with inhabitants engaged in factories and manual occupations, where individualism necessarily became subject to collectivism. In the human body there is differentiation of structure and function, and so

there is in the modern complex social organism; just as in the human body the failure of function of one organ may disturb the harmony of function of the whole body and mind, so in the social organism a strike, even by a humble section of it, may lead to disorganisation of the whole.

The collection of large numbers of people in towns and cities who were previously accustomed to individualism in matters of sanitation led to a most deplorable state of affairs, and Sir Edwin Chadwick, a pioneer in sanitary science, in whose honour these lectures were given, was the first to call attention to the necessity of legislation to remedy the growing evil.

In 1842 a report was published by him on "The Sanitary Condition of the Labouring Population of Great Britain." In this he called attention to the filthy conditions under which the English labouring classes lived. To remedy this, collective responsibility undertook the first stage of social reform by cleansing, lighting, and policing of the streets, and by establishing systems of water-supply and drainage in our cities and large towns.

The second stage of social reform was factory legislation, for regulating the conditions of work in factories, for protecting those employed in unhealthy occupations and industries, and for restricting the work of women and restraining the work of children. Like many other essential social reforms, it met with much opposition.

The third stage was the nationalisation of education in 1870, and the extension of the meaning of education has so far progressed that it now includes not only mental but also physical development, the exercising and even feeding of children where necessary, the care of the feeble-minded by the formation of special schools, medical inspection and notification of infectious diseases, treatment of children's ailments, and attention to the eyes, ears, and teeth at the school-age.

Last to occur, the effort to guard the child before the school-age, even as soon as it is born, even before birth through attention to the future mother. There is yet one other educational method of far-reaching importance to the masses, and that is the scout movement and officers' training corps, by which boys and youths are trained to become self-reliant yet unselfish, and submissive to discipline without losing individuality. That spirit of *esprit de corps* which is the striking feature of our public schools and universities is by this movement extended to the boys and youths of all classes, and it cannot fail to have an important influence upon development of character. Each of these stages has supplemented and reinforced the other; yet we hear on all sides the pessimistic cry of the degeneration of the race set up by a few unthinking people who advocate a "laissez-faire" or the so-called "better dead" theory of all those who are unable, through inborn lack of vitality, to resist racial diseases. Are we to

listen to these pessimists? No! Rather should we look with pride to what has been done in the last fifty years to better the condition of the people.

In respect to tuberculosis I will quote the words of a great French scientist uttered at the International Congress of Tuberculosis held in London in 1901. Professor Brouardel, of Paris, said in his address: "You have diminished the mortality in England from tuberculosis by forty per cent," and he attributed this decline to the numerous Acts of Parliament and measures promoted by private individuals to render more salubrious the dwellings of the poor and the conditions under which they live and carry on their occupation in factories, mines, and workshops throughout the kingdom. We can from this realise what a great work Sir Edwin Chadwick did in combating this racial disease by his pioneer work in sanitary science.

The housing of the poor is now the bedrock of physical and mental hygiene, and still calls for all the efforts which Parliament and private enterprise can exert. By energetic amelioration of the present conditions, especially those of the casual workers in cities, and of the rural population, more can be done than by any other means to "diminish" the death-rate from tuberculosis, the contamination of the morals of the poor and the infant mortality. The social reformer justly recognises that much good raw material may be spoilt by a bad environment; he recognises also the fact that a healthy mind

can only exist in a healthy body, and that an inborn virtue may by evil surroundings and imitation be the source of contracted vices. The ardent and enthusiastic social reformer should recognise the fact that you do not gather grapes from thorns nor figs from thistles; that the children of feeble-minded parents will, in spite of good nutrition and favourable surroundings, tend to be more or less feeble-minded; that the most dangerous form of feeble-mindedness (now that Nature is no longer left to itself to select by survival of the fittest) is the higher-grade imbecile, who is fertile and able under the easier conditions of survival brought about by social reform to multiply and infect good stocks. Seeing that we cannot prevent this occurring, every endeavour should be made to promote the efficient operation of the Mental Deficiency Bill to segregate early mentally defective children, in their own interests and in the interests of the community. Inasmuch as feeble-mindedness occurs in all classes, I should advocate notification of all mental defectives; and where parental responsibility has failed, then in the interests of the child the Government should take up the responsibility of guardianship as a protective measure—due precautions being taken and every opportunity given of restoration to social privileges, should it be found desirable by the properly constituted authorities. Some of these practical problems concerning mental hygiene will, I trust, be better understood by the public, if they will consider the subject from the physiological and medical

points of view, as well as from the economic and political.

Mental Hygiene from a Physiological Standpoint

Structure and Development of the Brain.—The most striking anatomical distinction of man from the anthropoid apes is the enormous increase in the development of the great brain—the cerebrum—and this increase in size is due almost entirely to an enlargement of that part of the great brain which occupies the cranial vault and gives to man a dome-like shape to the skull.

Gall, the phrenologist, more than one hundred years ago, was the first to point out that that part of the brain with which the higher mental activities are connected must be the cerebral hemispheres. He said: "If we compare man with animals we find that the sensory functions of animals are much finer and more highly developed than in man; in man, on the other hand, we find intelligence much more highly developed than in animals. Upon comparing the corresponding anatomical conditions we see," he said, "that in animals the deeper situated parts of the brain are relatively more developed and the hemispheres less developed than in man; in man the hemispheres so surpass in development those of animals that we can find no analogy." Gall moreover studied the brains of imbeciles and demented persons, and was the first to point out that the disorder and deficiency of mind of

the one, and the disorder and loss of mind of the other, should be correlated with the deficient development of the hemispheres in the feeble-minded imbecile and the destruction of the hemispheres in the demented lunatic.

Unfortunately Gall's imagination outstripped his judgment, and he wrecked his fame as a scientist by associating mental traits of character with conditions of the skull; then, encouraged by a wide-spread wave of popular sympathy in the endeavour to materialise and localise the functions of mind, he launched into speculative hypothesis unsupported by facts. His doctrine of phrenology was shown to be absolutely illogical; but the importance of his work in showing that the brain was the organ of mind has since been recognised.

Body and Mind.—Although the brain is the organ which stores the recollection of past experiences and the bonds that unite them, thereby enabling the individual to adapt himself to environment, yet strictly speaking the mind is directly dependent upon the vital activities and harmonious interactions of all the organs and tissues of the body; for of what use would the brain be without the peripheral sense organs and the nerves which connect them with the spinal cord and brain? These are the avenues of intelligence, as was clearly recognised by Aristotle in his famous dictum: "Nihil in intellectu quod non fuerit prius in sensu." But another fundamental function of the brain besides perception of the external world and its surroundings is the

consciousness of the individual's own personality, his appetites and desires, which are due in great part to the organic sensibility of the nerves of the body and internal organs, which without cessation are continually carrying messages to the brain, making us aware of our existence and our needs. The quality of the blood and the presence in it of subtle bio-chemical substances produced by secreting glands and the viscera have a profound influence upon states of consciousness and mental activity. It is the consciousness of feelings connected with the preservation of the individual and the preservation of the species which constitutes the fundamental biological source of all vital activity, and is thus poetically expressed by Schiller in the following lines :

> Durch Hunger und durch Liebe,
> Erhält sich die Weltgetriebe.

The mental states concerned with the consciousness of appetites and desires and the control of the instincts and habits associated with their gratification, the avoidance of pain and the obtaining of pleasure essential for the preservation of the life of the individual and reproduction are the mainspring of human activities, passions, and emotions.

Plan of a Simple Nervous System.—Let us now consider for a few moments the general plan of a nervous system.

The nervous system of all animals with a nervous system is constructed on the same plan.

As we rise in the zoological scale it consists of more and more complex systems and groups of neurones. A neurone is a nervous unit which consists of a nerve cell with branching processes ; one process becomes the axial core of a nerve fibre : this is termed the axon, the others are termed dendrons. All nervous action is reflex, and the simplest reflex act is the first term of a series, of which the most complex volition is the last. Therefore before proceeding to discuss the brain, the most complex organ in nature both as regards structure and function, let me call your attention to the simplest form of nervous system illustrated in this diagram. You observe S (fig. 1) is a sensory nerve cell with branching processes; one branch ends in the skin, the other branch proceeds centrally, and this you see breaks up into a number of fine terminals which are brought into relation with the branching processes of M^1, a motor cell ; proceeding away from this cell is a process, the motor nerve, which terminates in a muscle connected with the sensitive skin. Stimulation of the sensory nerve in the skin, it matters not whether it is chemical or physical, produces what is known as an afferent nervous stimulus, which travels in the direction shown by the arrow to the terminals of the sensory neurone S, where it excites the terminals of the motor neurone M, giving rise to an outgoing efferent current which stimulates the muscle and causes its contraction.

Let us suppose the stimulus to be a painful and therefore a harmful one, the effect of the

neuro-muscular mechanism will be a protective reflex action, the contracting muscle withdrawing the skin surface from the cause of the pain. You will observe that the diagram shows that the sensory neurone consists of a cell with a process which divides into two branches; one proceeding to the skin—this is the sensory nerve—the other branch dendron proceeding centrally to end in a terminal arborisation. The current of nervous action resulting from the stimulus always proceeds towards the centre; it is afferent; the fine terminals of the central projection of the nerve cell are in physiological (that is, functional) but not anatomical connection with the branching processes, dendrites of M, the motor cell. This alterable functional connection is spoken of as the synapse; the motor cell, M^1, gives off one process which becomes the essential conducting axial core of a motor nerve fibre which ends in the muscle; and the current of nervous action along this is always outgoing or efferent. We have thus two systems of neurones: (*a*) afferent sensory, (*b*) motor efferent. There is yet another neurone, A, which you observe associates the synapse of S and M^1 with a second motor neurone element M^2, which innervates another muscle that is antagonistic in its action to that supplied by M^1. Stimulation of the sensory nerve in the skin may give rise not only to reflex contraction of the muscle supplied by M^1, but also through the association neurone A, to relaxation by inhibition of contraction of the muscle supplied by M^2.

PLATE I

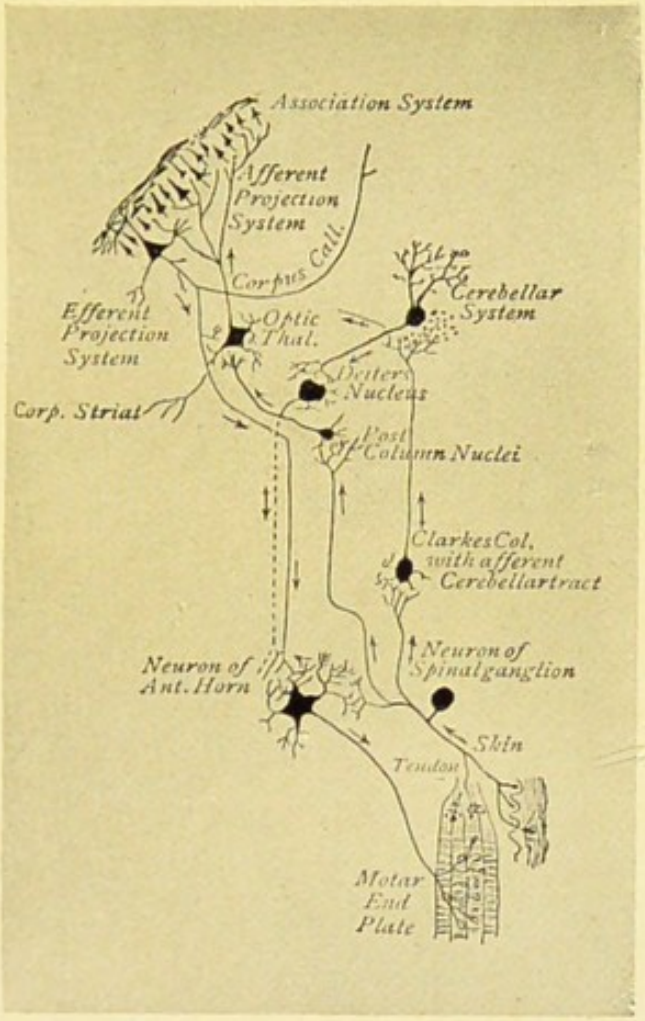


FIG. 1.—The three systems of afferent, efferent, and association neurones; Spinal, Cerebellar, and Cerebral necessary for perfect conscious voluntary movement.

It will be observed that when a muscle contracts under the influence of voluntary stimuli from the brain, alterations in tension of the skin, muscle, tendon, and structures of joints cause afferent impulses (kinæsthetic) to pass up to the brain. Every movement is associated with ingoing and outgoing currents The cerebellar system which is indicated by afferent and efferent systems is especially concerned with reinforcement of muscular action.

The special function of the brain is inhibition or control of instinctive reflex action, and this is done by its associative memory of past experiences.

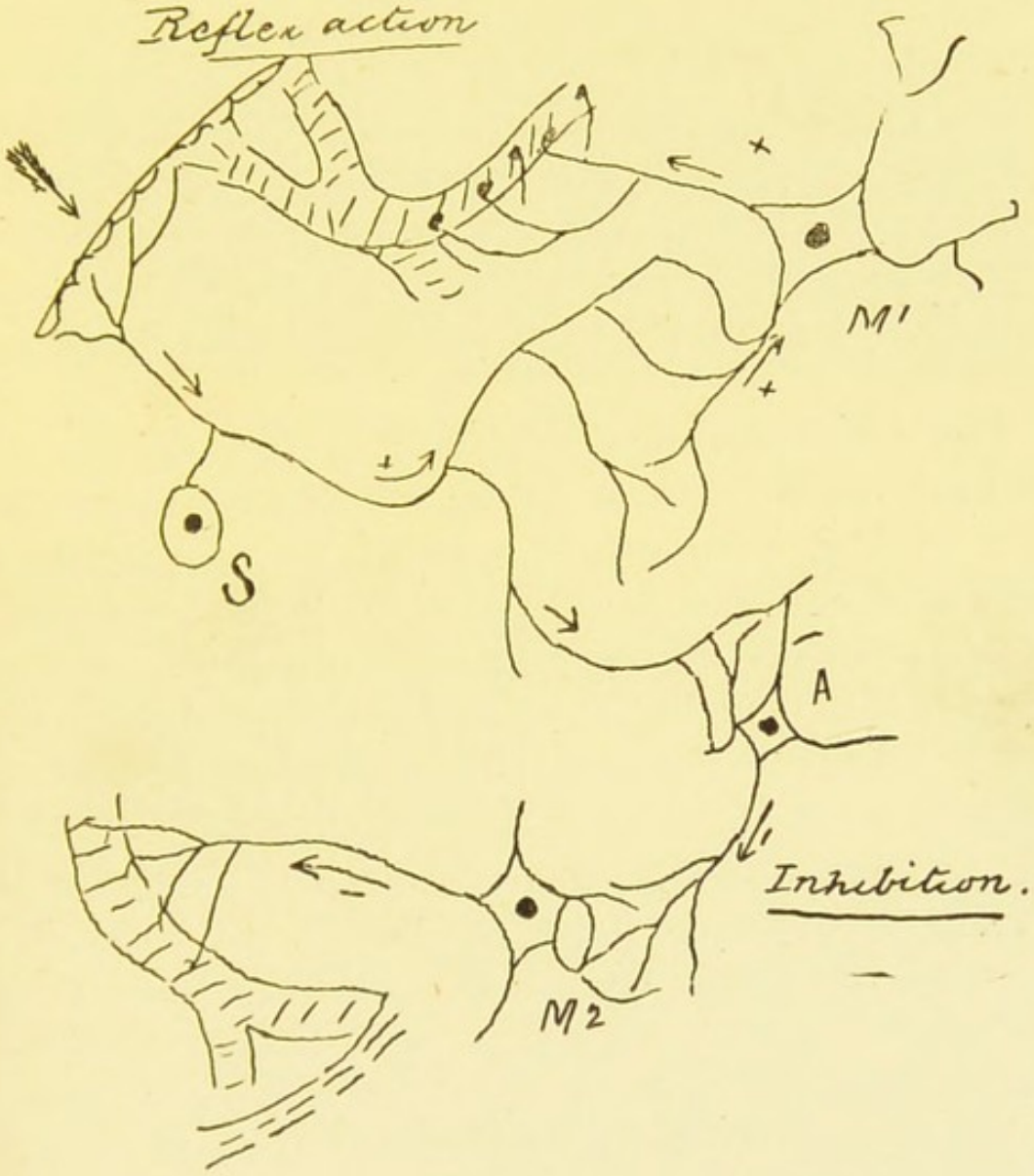


Fig. 1.

The neurones, I have said, are independent nervous units ; they are in anatomical contiguity but not in continuity. The cerebro-spinal and sympathetic nervous systems are made up of

neurones which we may regard as complex highly-differentiated cells obeying, however, the same laws of nutrition, repair, and waste as other cells of the body.

The neurones are the essential nervous elements, and they, together with the supporting connective tissue elements, neuroglia cells, blood vessels, and lymphatics, form the central nervous system. Functionally speaking there are three systems of neurones in the brain and spinal cord: (1) afferent projection system; (2) efferent projection system; (3) association system (Plate I, fig. 1).

The Convolutional Pattern of the Brain.—If we look at a human brain we see that the surface of the hemispheres exhibits a number of folds and fissures giving rise to a pattern which I will speak of as the convolutional pattern (Plate II, fig. 1). A section through any of these folds or fissures shows that the external surface or cortex, as it is called, is of a pinkish grey appearance contrasting with the dead white of the subjacent part of the brain. Now, a microscopic examination of the grey matter and the white matter explains why there should be this difference in colour. When highly magnified, a thin section appropriately stained by dyes shows the grey matter to consist of innumerable ganglion cells to and from which conducting fibres proceed. The microscopic architecture of the grey cortex exhibits a cell and fibre structure of extraordinary complexity. The diagram (Plate III, fig. 2) of a section of an adult brain

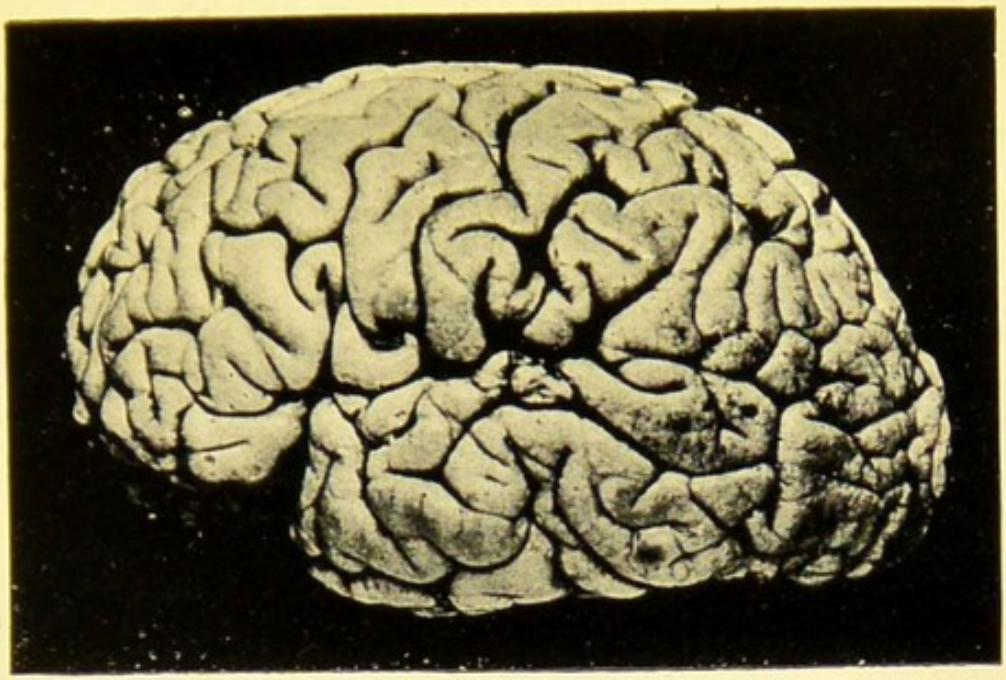


FIG. 1.—External surface of the left hemisphere of brain of an intellectual man showing a complex convolutional pattern.

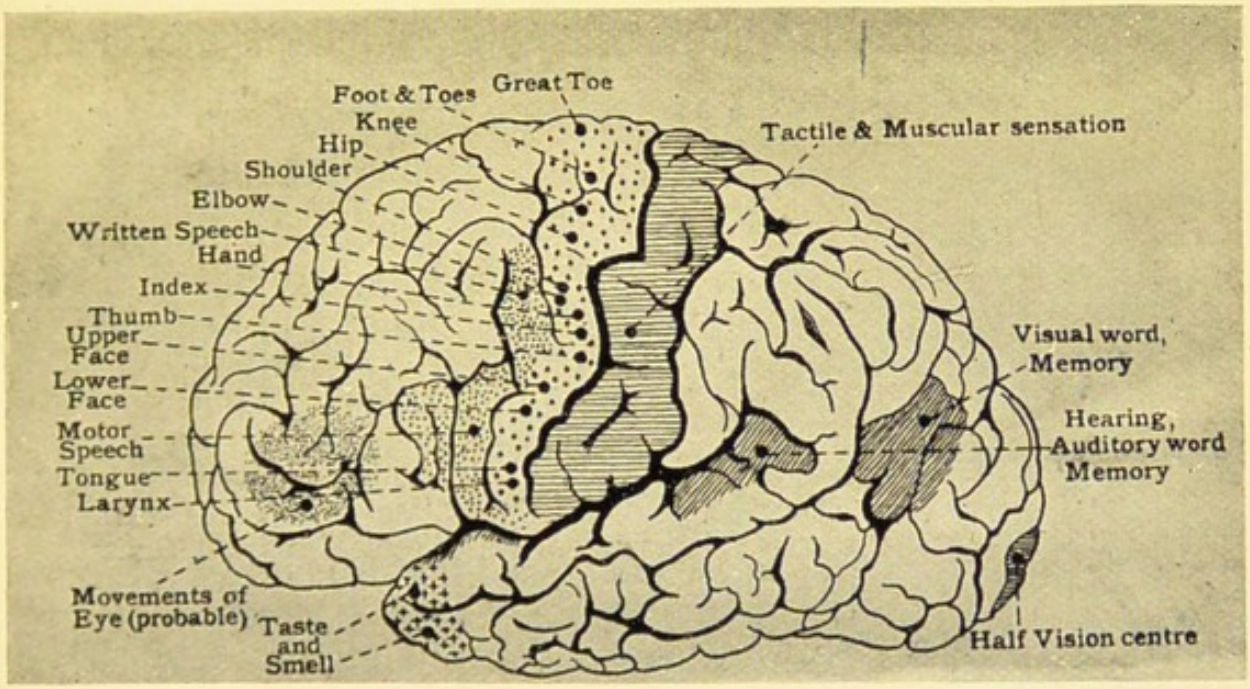


FIG. 2.—The same hemisphere as fig. 1, to show the various areas or ascertained definite physiological function.

The coarse black dots in the precentral region indicate points which when electrically excited give rise to the definite movements indicated. Behind the central fissure the cross shading indicates the region of tactile muscular sense. A large part of the auditory centre cannot be seen as it forms the floor of the posterior part of the Sylvian fissure. The greater portion of the half vision centre lies on the mesial surface and cannot be seen. The sensory speech centres are indicated by oblique shading; the motor speech centre of Broca is indicated by fine dots, and above it the centre for writing. Destruction of these centres cause respectively motor aphasia and agraphia.

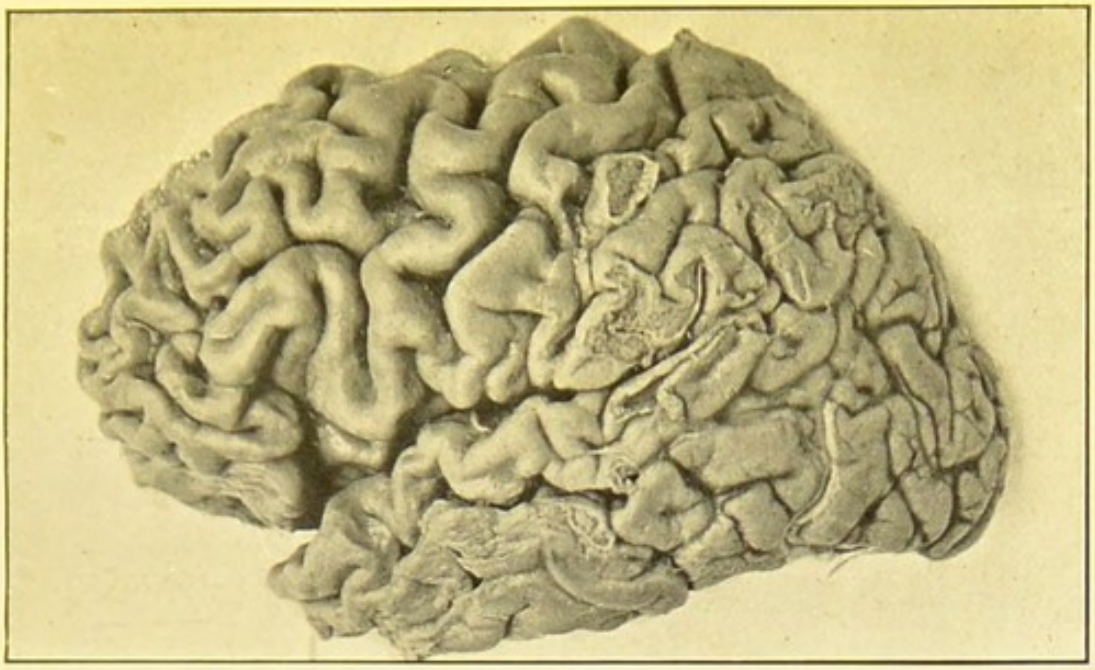
is to illustrate this cell and fibre architecture. You observe that the cells are arranged in six layers, and there are also layers of fibres, some of which run horizontally and some have a radial direction. The horizontal conduct association impulses. Although there is a general similarity in the cell and fibre structure of the cortex of the brain, yet the whole surface of the brain can be mapped out into territories of different cell and fibre architecture (Plate II, fig. 2); and physiology and medical science teach that there is a corresponding difference in function.

I have remarked that the grey cortex has a pinkish colour because (relatively to the white matter) the blood supply is very abundant. Now the subcortical matter is white because the nervous processes of the cells of the grey matter are surrounded with a sheath of myelin or phosphoretted fatty substance. The bio-chemical processes incidental to all nervous action, therefore to the mental activity of the brain, take place in the cell-structure of the neurone. The cortex is the seat of consciousness and mental activity, and the functions of the cortex require a continuous supply of oxygenated blood. Unconsciousness occurs if the blood supply fails for a few seconds, hence we understand why the superficial cortex of the brain is pinkish and receives so abundant a supply of blood.

Now if we look at a child's brain before birth at an early period, the surface is quite smooth and there is no internal white matter. As the embryo grows, primitive folds and fissures ap-

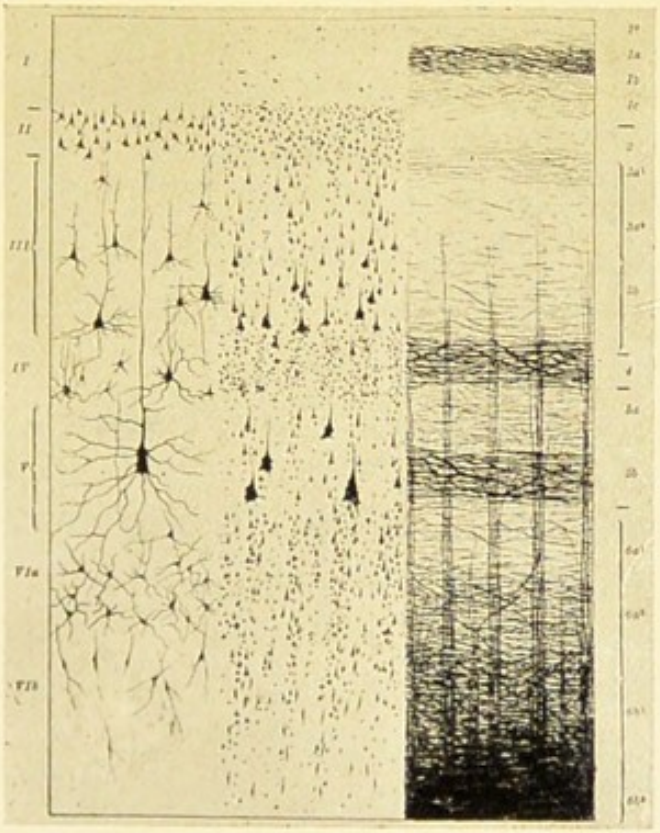
pear, and a month or so before birth we have a brain characteristic of the species; at birth we have the brain of the individual; the convolutional pattern formed by the folds and fissures (as with the physiognomy) may bear a resemblance to other individuals, but will exhibit features which differ from other individuals (Plate IV, figs. 1, 2). No two patterns are identically similar any more than two faces are identical; but just as the faces of relatives are likely to be similar, so Karplus showed that the pattern of the brains of infants who were related exhibited similarities; and Dr. Edgar Schuster, at my suggestion, and from material with which I provided him, has carefully investigated and recorded the similarities in the brains of adult relatives.

Now we may ask: Why should the brain exhibit these folds and fissures? The blood vessels which supply the brain lie in the fissures, and are thereby protected from pressure; but probably economy of space determines the balance between the dynamic forces which determine the growth of the skull and the growth of the brain, and by throwing into folds the grey matter, its area is increased enormously without increasing the size of the head. A very small head means a small brain and mental deficiency, and the simpler the convolutional pattern (that is, the fewer the folds and fissures) the less will be the extent of the grey matter, and consequently the fewer the number of neurones. It is not surprising, therefore, to find that not only



IG. 1.—The left hemisphere of the brain of a chronic lunatic who has become grossly demented.

bserve the broad deep fissures caused by the wasting of the grey matter of the cortex, particularly of the frontal lobes. The convolutions are shrivelled, and a microscopic examination of them would show chiefly a destruction of the cells and fibres constituting their microscopic architecture.



IG. 2.—Diagrammatic illustration after Brodmann of the cell and fibre architecture of the cerebral cortex.

here are six layers of cells and six layers of fibres. To the left are exhibited the different types of cells in the successive layers stained by the silver method, which only picks out a few cells. In the next column all the cells are stained by the Nissl method. Number IV layer consists of small granules, and above this are three layers of pyramids. Below the granules are larger pyramids in the layer V. Beneath this in the sixth layer are multiform cells. In the next column is represented the fibre structure; the vertical fibres are projection fibres carrying impulses afferent and efferent to and from the brain cortex. The layer of pyramids above the granules is especially connected with the function of associative memory. The horizontal systems of fibres are association systems.

are the brains of idiots and imbeciles deficient in the relative proportion by weight of the cerebral hemispheres to the rest of the brain, but the convolutional pattern is simple, consequently the superficial area of cortex is diminished (*vide* Plate IV, figs. 3, 4). The degree of amentia or congenital absence of mind is proportional to the failure of superficial extent of the grey matter of the cortex—the anatomical basis of mind. Savage man has a superficial area three times that of the gorilla, but a microcephalic idiot's brain weighed only eight ounces (Plate IV, fig. 3). Not infrequently an idiot or imbecile has a large head caused by distension of the cavities of the brain with fluid—hydrocephalus, popularly known as "water on the brain"—or there may be overgrowth of the connective tissue, causing arrest of development of the nerve cells and fibres—the essential structures of mind.

Microscopic Examination of the Brain of the Child before Birth and after Birth, and What it Teaches.—There is no white matter in the cerebral hemispheres before birth, because the myelin sheath of the nerve fibres has not been deposited around the axial processes of the afferent, efferent, and association fibres proceeding to and from the cortical grey matter. Appropriate staining of thin sections of the brain shows no evidence of myelin sheath formation. Now when the myelin sheath is formed an indication is afforded that a particular system of nerve fibres is capable of functioning by conducting nervous impulses. We shall see that

this important fact has been made use of by Flechsig for showing certain fundamental principles connected with the development and correlation of structure and function in the growing infant's brain after birth. But before proceeding to discuss this I will consider the structure of the grey matter—the cortex—of the child's brain before birth. Examined microscopically, we see that it consists of six layers of cells, as the diagram of the adult brain shows, with individual differences in different parts; but these differences are not so marked as in the adult brain. In fact, Brodmann has shown from his studies of fœtal brains that the six-layer type is the characteristic type.

We also observe that the cells are very simple in their form, and that they are closely packed together, forming columns and layers. They increase in size and they grow and develop by pushing out processes which extend like the branches of a tree (fig. 2). There are two types of neurone: the first type, the larger, in which a process of the cell called the axon leaves the grey matter; it becomes covered with myelin and forms a nerve fibre. In the other, the second type, the axon never leaves the grey matter. It is probable that these two different types of neurones have fundamental differences in function. The small second type is especially numerous, forming a dense layer in the sensory regions of the cortex of the brain. The sensory projection system of fibres conveying nerve currents from the muscles and special sense organs to

the brain terminate in the layer of small neurones.

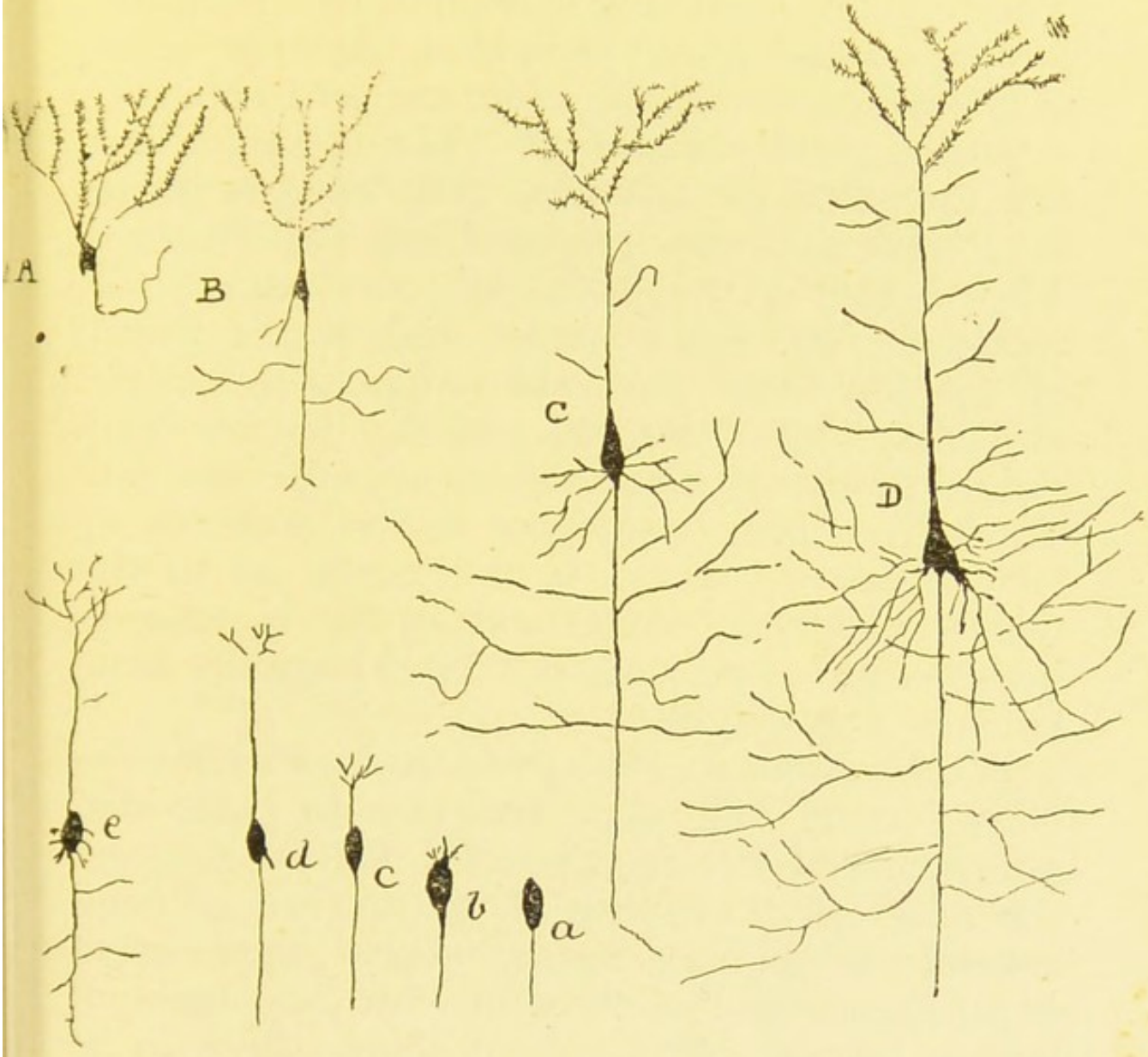


FIG. 2.—Diagram after Ramon y Cajal to show the phylogenetic and ontogenetic development of a psycho-motor neurone.

A, frog; B, newt; C, mouse; D, man. It will be noticed that in ascending the zoological scale there is an increase in complexity of the neurone and in the multitude of points of contact produced especially by an increase in the dendrons and dendrites, also but to a less degree by the collaterals of the axon. *a*, *b*, *c*, *d*, *e*, show the development of a psycho-motor cell in the human embyro as it grows. Neurones may be arrested in their growth, and in the brains of idiots an arrest takes place.

The new-born male brain weighs 321 grams; the female 361 grams. In the course of the first

nine months the weight of the brain is doubled, and microscopic examination shows why this is. The myelin insulating material has been deposited around a large bulk of the axon processes of the neurones and the white matter has in consequence greatly increased. The neurones have not increased in numbers, they have increased in complexity and preparedness for function. The weight of the brain still continues to increase for the same reason, and in the course of the first three years the weight is treble that at birth. After this the addition to the brain weight gradually diminishes in amount, and only slowly continues to increase in the male sex up to nineteen or twenty ; in the female up to sixteen to eighteen. After sixteen the increase in brain weight is very slight. In old age the brain tends to lose weight.

Myelination and Preparedness for Function.— Now let me call your attention to these diagrams after Flechsig (Plate IV, fig. 5) ; you see the dots on these two diagrams are situated around the primary fissures which physiological experiments and observations on the brains of human beings suffering from disease show to be the arrival and departure platforms of the sensory and motor impulses. The portion of the brain where voluntary motor impulses are generated for the control of movements of the opposite side of the body lies in front of the central fissure ; behind the central fissure is the central station for the reception of impulses from the skin, muscles, joints, and tendons and

FIG. 1.—Left hemisphere of six to seven months' fœtus, showing the primary fissures. This appearance is common to the species.

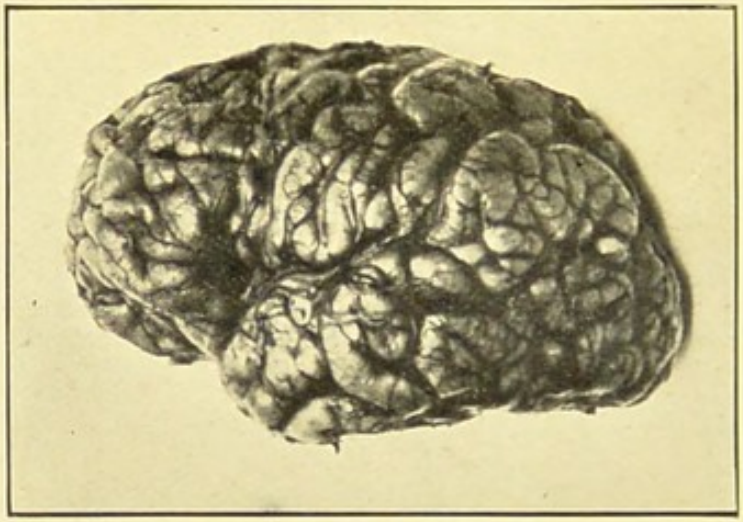


FIG. 2.—Left hemisphere of new-born child, full term, showing the complex convolutional pattern peculiar to the individual.

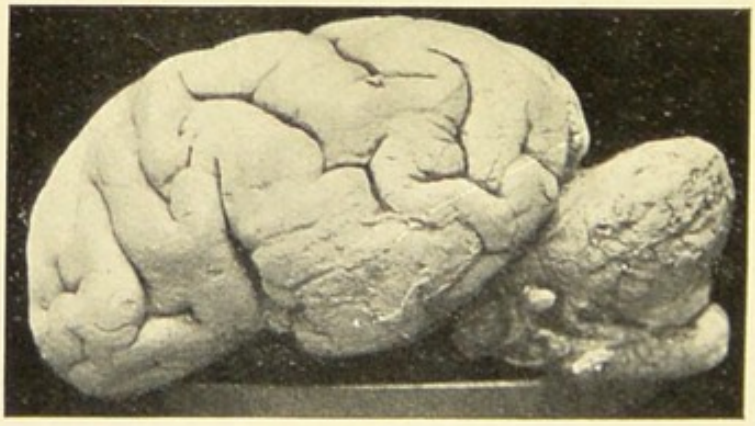


FIG. 3.—Brain of microcephalic idiot. Notice that the cerebellum is almost entirely uncovered, owing to the failure of development of the cerebral hemispheres. This arrest of cortical development is also indicated by the very simple convolutional pattern.

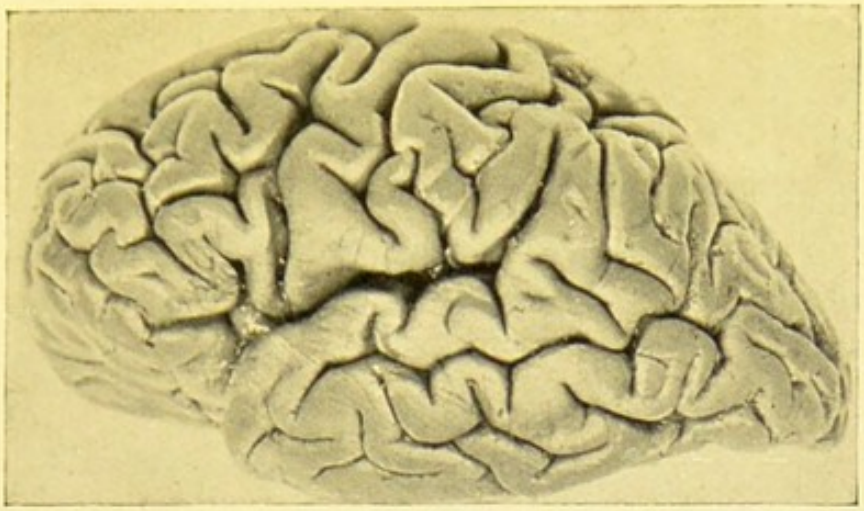


Fig. 4.—Left hemisphere of a low-grade imbecile; there is a great failure of development of the parietal lobe and the convolutional pattern is very simple in comparison with the normal (Fig. 1, Pl. II).

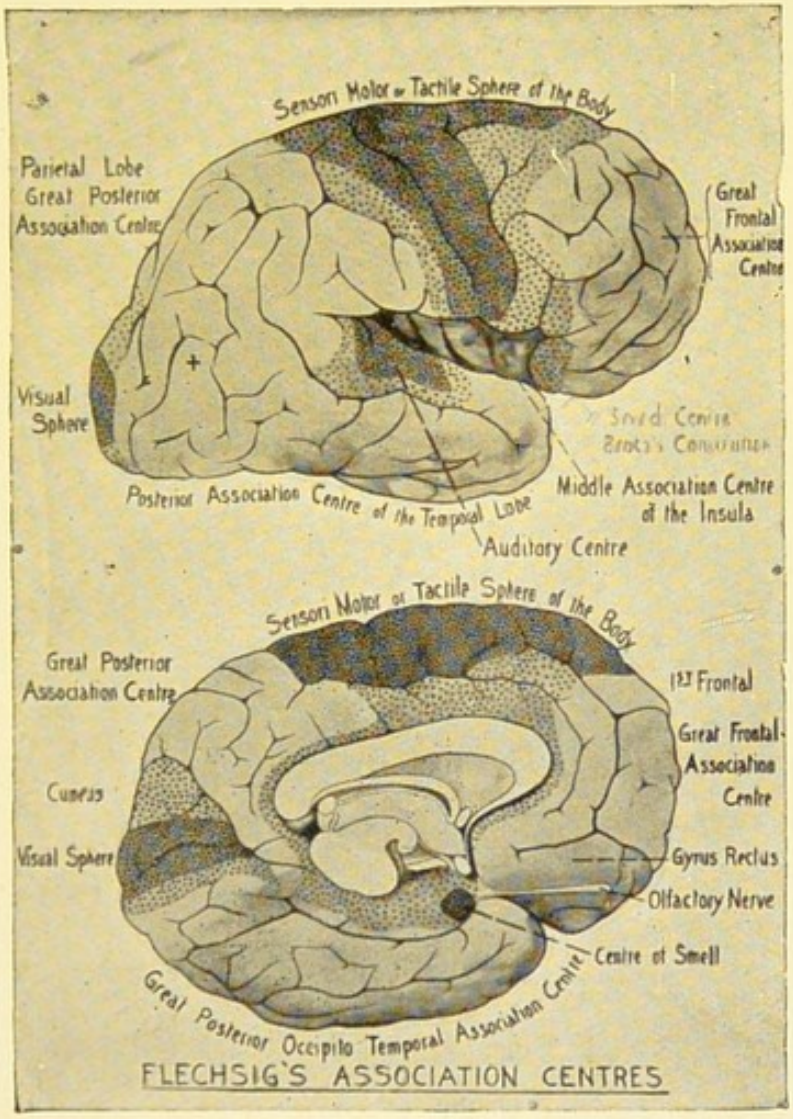


Fig. 5 is a diagram showing the projection and association centres of Flechsig as seen on the external and internal surfaces of the right hemisphere. The dotted areas are the regions of the cortex which are first myelinated, because they constitute the arrival and departure platforms of the sensory and motor projection systems of fibres. The remainder of the cortex is myelinated at successively later periods, and correspond to those regions of the brain which have been termed association centres.

the general organic sensibility of the body. The half-vision centre occupies the posterior part of the brain; only a small portion of this cortex is here seen, because the greater portion is deeply situated in the floor and walls of the calcarine fissure on the mesial surface. The centre for hearing sounds, especially in the opposite ear, is also in great part hidden from view, occupying the posterior part of the floor of the Sylvian fissure; likewise the cortex having for its function the sense of smell is almost completely hidden; this sense is shown as occupying a region at the tip of the temporal lobe.

The Association Centres.—The portions of the cortex indicated by dots situated around the primary fissures are, according to Flechsig, the arrival and departure stations for afferent and efferent stimuli. He terms them Projection Centres. But it will be observed that the greater part of the surface grey matter of the brain in Plate IV, fig. 5 shows no dots indicative of projection systems; these areas Flechsig terms "the association centres"; and although in man the afferent sensory and motor efferent projection centres occupy a larger surface area than in the highest anthropoid apes, it is especially the great development of the association centres which accounts for the fact that the cerebral cortex of a savage even is three times as extensive as that of the gorilla. Now, how do we know by a study of the brain of the new-born child compared with the brain at later periods of growth that the projection systems are

localised in the regions indicated? I have already told you that by appropriate staining the myelin sheaths of nerve fibres can be detected in microscopic sections of the brain. I have said that the cerebral hemispheres at birth only show staining indicating preparedness for function in the base and stem of the great brain. The structures which are stained in Plate V, fig. 1 are the systems of neurones essential for the performance of the complex, automatic, coordinate movements of the new-born child—viz. breathing, crying, sucking, swallowing. Occasionally anencephalous monsters are born in which this is the only portion of the brain present, the cerebral hemispheres being absent. Such monsters are capable of breathing, crying, sucking, and swallowing by the preorganised nervous mechanism in the stem of the great brain which is present in these creatures. The first appearance of myelin staining after birth is in the regions about the primary fissures—the sensory afferent projection systems, the avenues of experience and intelligence; later the motor efferent projection system is myelinated. You observe that these several sensory perceptual centres of vision, hearing, smell, taste, and tactile-motor perception are independent. At this stage of development the child is capable of experiencing a simple elemental sensation, but later, as the association neurones take on function as indicated by myelination of their fibres, the independent perceptor centres are physiologically connected and functionally as-

sociated. That being the case, the child is no longer capable of a simple sensation. You have only to watch an infant follow with its eyes a bright object; it makes very clumsy efforts at first, it does not recognise what the object is; but after a time and numbers of experiments it learns to stretch out its hand to get it, and if it succeeds it will take it to its mouth; nutrition is its object. If the spoon contains sugar the infant, having experienced the pleasure of sweet taste, at the sight of the spoon exhibits satisfaction and attempts to grasp it; this means that the visual centre has been associated with the motor centre, and the successive movements it makes successfully to grasp the spoon cause sensory impulses from skin, muscles, tendons, and joints to be registered in the sensory tactile-motor sphere, so that after numerous experiences association for the eye and hand is effected. Suppose the infant is subsequently given a powder in the spoonful of sugar, the sense of taste and smell is excited and disgust produced, with signs of nausea, spitting out, and crying. A new experience has been made, and the sight of the spoon, instead of awakening pleasurable feelings, will arouse disgust and aversion by associative memory. As Galton in his inquiries into the human faculties truly remarks: "The furniture of a man's mind chiefly consists of his recollections and the bonds that unite them. As all this is the fruit of experience, it must differ greatly in different minds according to their individual experiences."

A glance at this diagram of a section of the brain of a five months' child shows you that the whole of the white matter now contains myelinated fibres and all the primary projection centres are associated with one another (Plate V, fig. 2).

The Anatomical Substratum of Mind.—The proportional weight of the stem of the brain and cerebellum to the whole brain should be as 1 to 8. In the case of the idiot, the imbecile, and the dement the proportion is much lower—viz. 1 to 6 or even less. In the idiot and imbecile the superficial area of grey matter is greatly diminished; in the dement the grey matter is wasted and destroyed. Not only do we see these obvious defects, but if we compare the microscopic appearances of a section of the normal brain, stained so as to show the cell and fibre architecture, with a section of the brain of a congenital feeble-minded person and the sections of the brain of a lunatic who is demented or has lost his mind, we shall find in the case of the ament born with deficient mind a deficiency of cells and fibres in his cortex; the superficial pyramidal cells which give rise especially to the association fibres are poorly developed and deficient in numbers; the cells have but few branching processes and are incomplete in their development, and there is not only, as I have said before, a parallelism between the diminished superficial extent of the cortical grey matter, but there is also a parallelism between the depth of the mental deficiency and

PLATE V

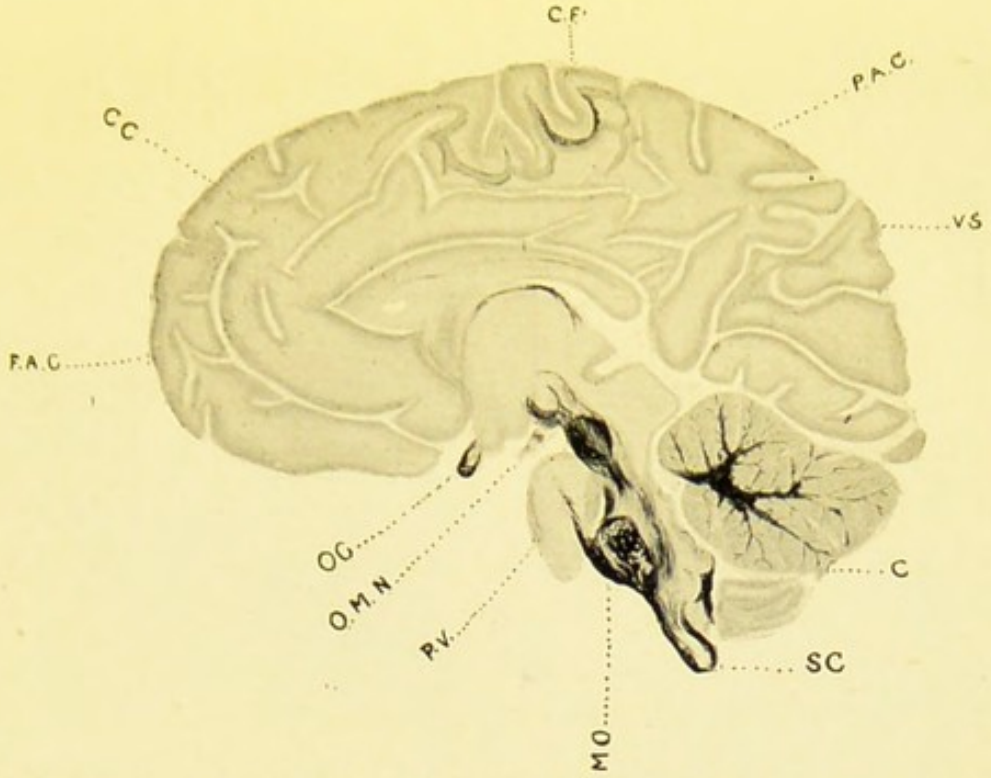


FIG. 1.—Diagram of vertical section through the brain of a new-born child stained by the Weigert-Hæmatoxylon method to show myelination of the fibres.

All the parts which are dark contain myelinated fibres. Attention is particularly directed to the staining about C.F., the central fissure which corresponds to the tactile-motor area. It will be observed that the remainder of the cortex is unstained. M.O. medulla oblongata; P.V. pons varolii; O.M.N. oculo-motor nerve; O.C. optic commissure; F.A.C. frontal association centre; C.C. corpus callosum; C.F. central fissure; P.A.C. posterior association centre; V.S. visual sphere; C. cerebellum; S.C. spinal cord.

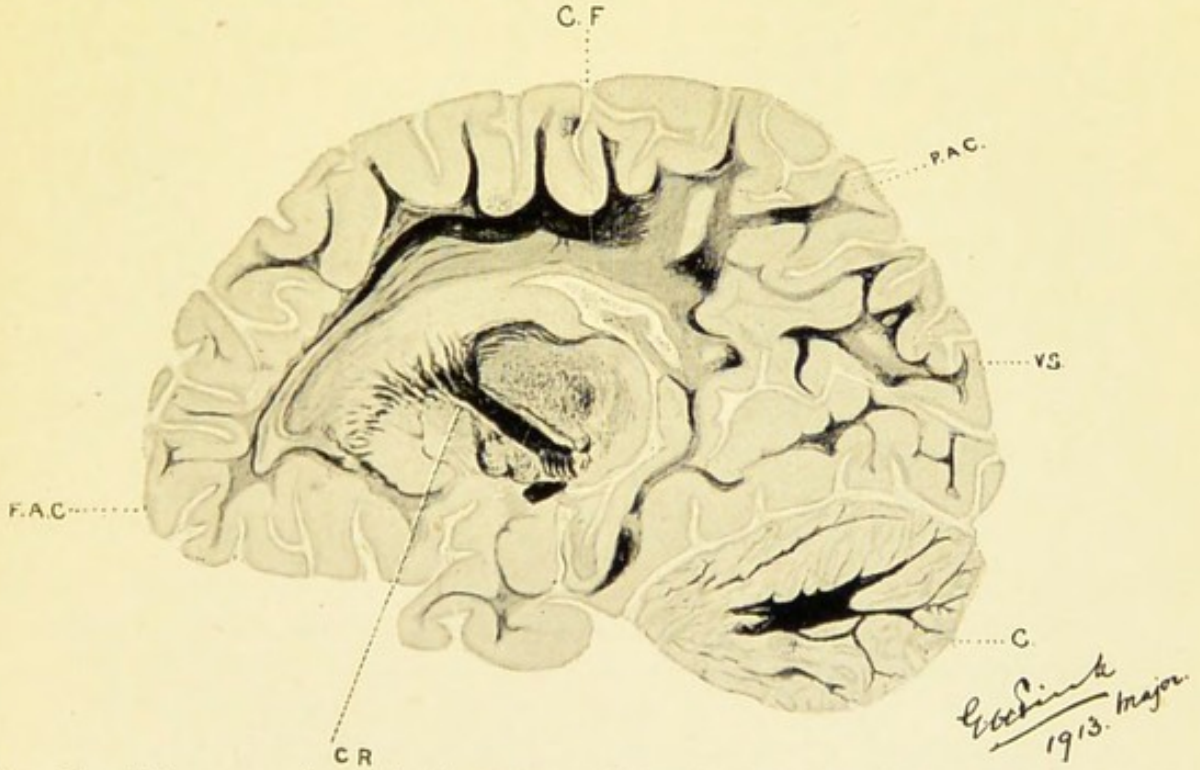


FIG. 2.—Diagram of vertical section of the brain of a child of five months.

The greater part of the brain now shows, by the staining, myelination of the white matter thus indicating functional activity of the association centres. F.A.C. frontal association centre; C.F. central fissure; P.A.C. posterior association centre; V.S. visual sphere; C. cerebellum. It will also be noted the corona radiata and internal capsule C.R. which were not myelinated in fig. 1 are now myelinated, as shown by the staining in the basal ganglia.

the failure in numbers and development of the nerve cells and fibres. Correspondingly, in the loss of mind of a chronic lunatic there is gener-

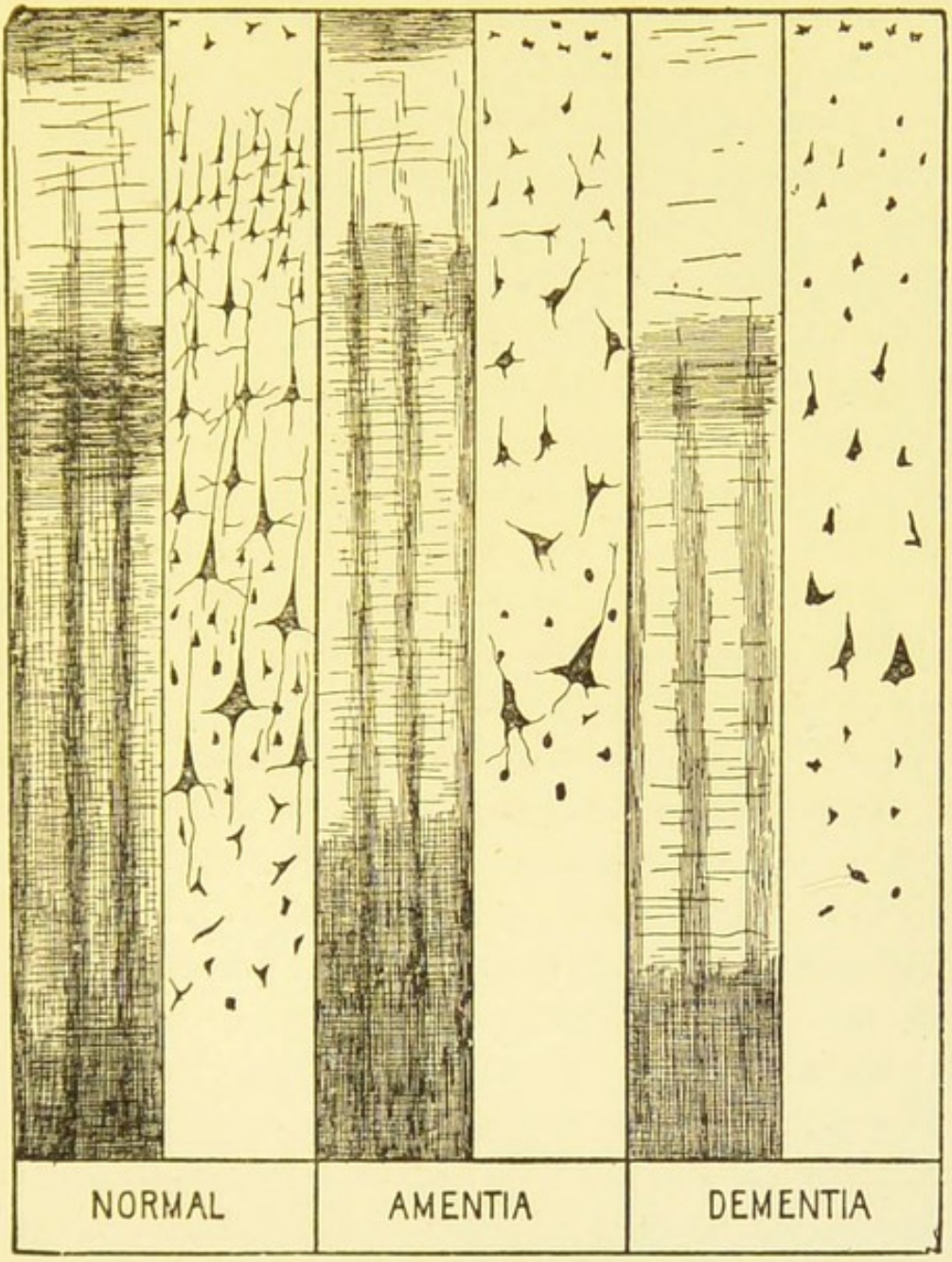


Fig. 3.—Diagram to illustrate the comparative architecture of the cortex, of the healthy normal brain, of the brain of the feeble-minded (inborn amentia), and of the brain of the dement who has lost his mind.

Observe that the cells have lost their processes and are shrunken and irregular in form, also note the comparative poverty of fibres, especially of the horizontal association fibres in Amentia and Dementia.

ally a parallelism between the decay and atrophy of the cortical grey matter and the degree of dementia; the deeper the dementia (loss of mind), the greater are the number of nerve cells and fibres destroyed or undergoing decay and destruction (Plate III, fig. 1). I think then I have shown you sufficient evidence to prove that the cortex cerebri is the material basis of mind.

Causes of Mental Failure.—We must now recognise the two great groups of causes of mental deficiency or failure of the brain to develop: (1) Germinal or gametic, an inborn failure of the germinal determinants of the cortical neurones, whereby the neuroblasts or primordial cells from which the neurones develop may, in consequence of an inherited defect, be deficient in numbers or deficient in specific energy, consequently they do not grow and develop. "Like tends to beget like," and the cause arises in most cases from defective progenitors. If one parent be feeble-minded, only some of the offspring will be mental defectives. If both are feeble-minded, the chances are the whole of the offspring may be more or less feeble-minded. It was calculated by the late Dr. Ashby, a very experienced children's physician, that 75 per cent of the mental defectives owe their mental deficiency to inborn germinal defect. Mentally defective children of this type may be born to normal parents, but the chances of such occurring are extraordinarily less than if a parent is feeble-minded, epileptic, or insane, or exhibits other signs of the neuropathic inherit-

ance. (2) Mental deficiency from other causes occurs in 25 per cent of the cases, and this includes pre-natal, natal, and early post-natal conditions. The pre-natal conditions are those associated with disease of the mother, especially from such poisons as syphilis (giving rise to congenital syphilis), lead and alcohol, injuries, falls and depressing conditions by which the developing offspring is imperfectly nourished, and absence of the thyroid gland, which gives rise to myxœdematous cretinism. Natal or post-natal causes are difficult labour, fevers and poisoning in early infancy, which cause arrest of the development of the brain cortex; its damage may also be occasioned by rupture of blood vessels and tumours. It is extraordinary how well the brain is protected from injury and failing nutrition of the body. In starvation all the tissues of the body waste away, yet the brain loses hardly any weight at all. Donaldson at the Wistar Institute has clearly shown by a large number of experiments on white rats that the growth of the brain is hardly at all impaired by insufficient food. He took litters of white rats and divided them into two groups; one group he fed well, the other insufficiently. Although there was a great difference in the weight of the bodies of the two groups, the brains showed hardly any appreciable difference—proving that all the tissues of the body may suffer in order that the brain may grow. This shows that the neurones have normally a great inborn specific energy, as they should have, for

they are perpetual cells of the greatest importance for the preservation of the commonweal of the social organism of the body.

All the neurones are present at birth with all their latent potentialities; some are fully developed; the majority, especially the neurones of the grey matter of the surface of the brain, are in their infancy; those which in the process of evolution have been the latest to appear—the association neurones—will be the latest to complete their growth by extension of their processes. I have said these cells are perpetual cells; by this I mean that in a healthy brain they are endowed with a durability to function during the life of the individual. Unlike the cells of the body generally, neurones destroyed cannot be replaced. They are the master-cell-elements for the preservation of the individual, as the reproductive cells are the master cells in the preservation of the species, and they are functionally interdependent.

THE INBORN POTENTIALITY OF THE CHILD

By the inborn potentiality of the child I do not mean altogether what the child is born with, for it might be born with a disease or defect which was really not inherited, but due to injury or disease acquired by the developing embryo before birth. Now in order to make the distinction between hereditary conditions and congenital conditions of the child quite clear to you, it is necessary for me to explain some essential facts concerning heredity.

All the broad facts concerning heredity were known to the ancients, as is clearly shown by the poet and philosopher Lucretius, who in "De Rerum Naturæ" says: "Sometimes, too, the children may spring up like the grandfathers, and often resemble the forms of their grandfathers' fathers, because the parents often keep concealed in their bodies many first beginnings mixed in many ways, which, first proceeding from the original stock, one father hands down to the next father; and then proceeding from these, Venus produces forms after a manifold chance, and repeats not only the features, but the voice and

hair of the forefathers; and the female sex equally springs from the father's, and males go forth equally from the mother's body, since these distinctions no more proceed from the fixed seed of one or other parent than our face and bodies and limbs. Again, we perceive that the mind is begotten along with the body and grows up together with it and grows old along with it." It was the custom, you remember, of noble Romans to carry in their triumphant processions the masks of their ancestors; consequently many of these facts became apparent to them.

Of the broad principles of human heredity we know very little more than this ancient philosopher. Science, aided by the microscope, has taught us much concerning the material basis of inheritance; it has shown that plants and animals are reproduced on the same common plan of a dual inheritance from the male and female germs. Let us briefly consider the union of the male and female germs in fertilisation in the higher animals, for it will help you to understand some of the problems of inheritance.

The male germs are formed in countless millions in the male reproductive organs. The female germ-cells, ova or egg-cells, are contained in the ovaries; they are about 40,000 in number at birth, and the germ which constitutes the material basis of inheritance is a minute round body in the cell (fig. 4, 1). When the ovum ripens (2, 3), which occurs periodically, one half of this germ is cast out of the cell. Why is this? It is to make way for a union

with the incoming male germ, the bearer of the potential inheritance from the male, as the female germ is from the female. These two germs constitute the woof and the warp of the material basis of inheritance; while the male germ brings

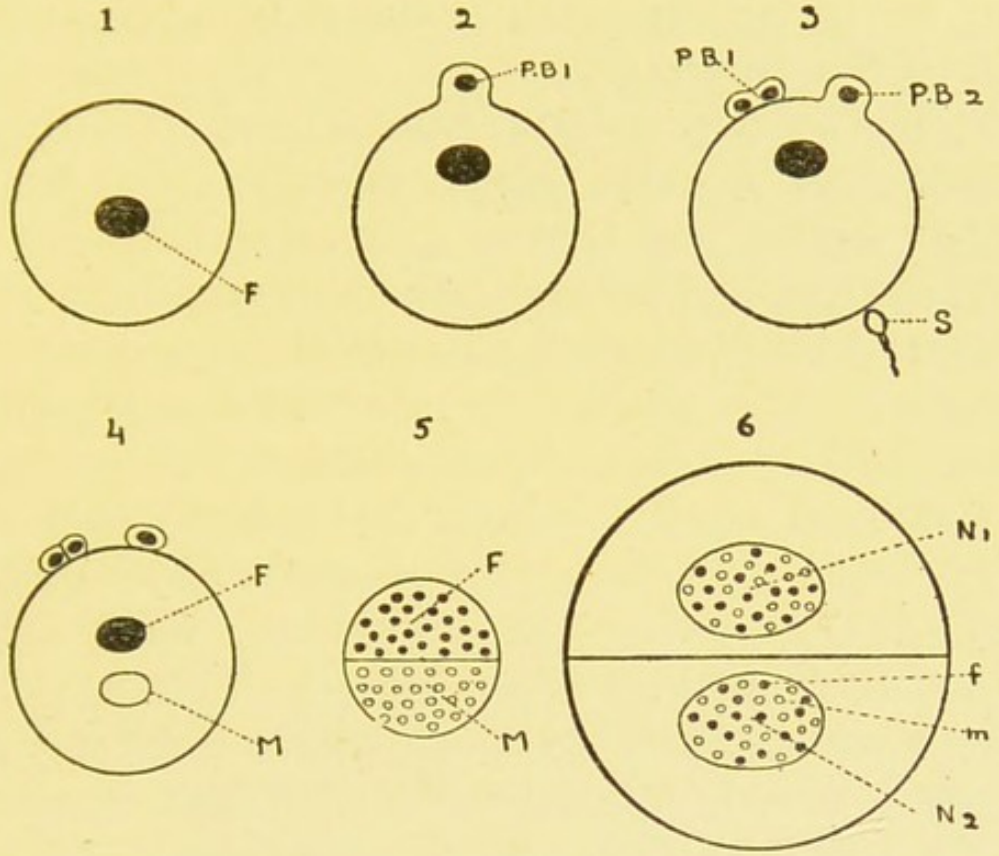


FIG. 4.

(1) Diagram of egg-cell before ripening. (2) Maturation or ripening of the ovum casting out half of the nucleus to form the first polar body. (3) Formation of second polar body and entry of spermatozoon (S) into egg. (4) Approximation of (M) male and (F) female germs. (5) Enlarged diagram of the two germs (F and M) before the first cleavage of the egg. (6) Enlarged diagram of egg after first cleavage. P.B1, first polar body; P.B2, second polar body; S, sperm; N1 and N2, nuclei of first two cells of the organism containing representative particles (germinal determinants) of (F) the female germ and (M) the male germ.

in a body called the centrosome, which acts as the shuttle which weaves the woof into the warp. The main substance of the egg-cell surrounding the germinal substance or nucleus provides the material out of which fresh nuclear material is

built until division of the nucleus occurs (6); the cell then divides, and the process is continually repeated. In the case of other eggs—*e.g.* that of the chicken—there is sufficient material to build up the young chick; in mammals, however, the fertilised egg-cell receives its nutrition after a short time from the blood of the mother.

The reason why I have endeavoured, in simple language, to explain these facts to you is in order to make you better understand the essential biological fact of reproduction and how it is necessary to the perpetuation of the species; also to explain the differences between congenital disease and true hereditary disease. As soon as the fertilised ovum, which is to form first the embryo and then the child, is nourished by the blood of the mother, it is liable to be affected by poisoned states of her blood. The best example I can offer of this is syphilis affecting the maternal blood, whereby the embryo is killed or the child is born with congenital syphilis. But you may ask: Can the male germs be in no way affected by the fact that the man had had syphilis, or that he had been a chronic drunkard, or suffered with chronic lead poisoning? This is a crucial point in the study of heredity. "The neo-Lamarckian doctrine of the inheritance of acquired characters is a question of great social importance. It does not assert that a change produced in an individual by functional activity or external conditions is inherited at once and completely by that indi-

vidual's offspring ; but what the neo-Lamarckians mean is that when a certain functional activity produces a certain change in one generation, it will produce it more readily in the next and so on—until ultimately structural modifications will appear in the young even before the function which has produced them has commenced, and the process may go on indefinitely until the structural character in question will be inherited for many generations after the exercise of such a function has altogether ceased." (Cunningham.)

The majority of biologists deny the possibility of the transmission of an acquired character, and I would agree up to a certain point that there is no evidence or proof that an acquired character can be transmitted. That a father who drinks heavily and sees his wife and family starving transmits the *desire* to drink in his offspring is illogical and unproven ; but he may transmit that inborn character which will lead to his offspring drinking—viz. lack of moral sense and feeble will. Are the Scriptures, then, wrong in saying that "the sins of the fathers are visited upon the children even to the third and fourth generation" ? and when I come to deal with the question of Insanity and how I believe Nature is continually striving to end or mend degenerate stocks you will ask : What then is the reservoir which is continually supplying degeneracy ? Is it a continuous fresh generation of poor types consequent upon the pathological factors of modern social conditions, or is it that natural selection and survival of the fittest are less effec-

tual in weeding out poor types? How far is medical science, legislation, and collective responsibility replacing family responsibility, thereby interfering with natural selection and survival of the fittest? Let us view these questions from a physiological standpoint. I will take the male germs which are continually being produced in countless millions for the greater part of a man's life. Each germ is the bearer of an extraordinary specific potential energy; and it produces effects far more complex and wonderful than the emanations of a similar sized speck of radium. The reproductive organs that produce these germs are contained in the body and nourished by the same blood and lymph. Although physiology proves that Nature in a marvellous way has protected the brain, which is essential for the preservation of the individual, and the reproductive organs, which are essential for the preservation of the species, and has established, by subtle bio-chemical influences in the blood, a correlation of functions of the two, yet it is a fact that in prolonged conditions of poisoning of the blood the brain suffers permanently in the production of specific energy, as shown by failure of its higher functions, and the male germ cells, which are continually building up the spermatozoa out of constituents taken from the blood, may by analogy suffer in their specific energy and vitality. If the devitalising agency caused by a poisoned condition of the blood is carried on in several successive generations, and especially if reinforced by a similar loss of specific

energy in the female germs from similar and other causes, weakly types of offspring will be produced, and these weakly types, being more susceptible to infective diseases, will be cut off early by invading microbes, especially by tuberculosis. But is the transmitted lack of vital energy generally enough to account for mental degeneracy? Mental energy is mainly used up in the exercise of will-power and attention in acquiring knowledge and making new adaptations to environment, and controlling and regulating the instincts and desires to the best advantage of the individual in the struggle for existence in the social life. Now a healthy mind can only exist in a healthy body, and the proper storage of mind-energy, its liberation, as well as recuperation (all necessary for a well-balanced mind), are largely dependent upon an inherited good and virile constitution; whereas the higher functions of the mind on the side of feeling, viz. imagination and the affective nature, are specifically inherited, and more dependent upon inborn variation from the normal average mind.

I have not time to discuss Galton's Law of Ancestral Inheritance nor Mendel's Law; I will only say in respect to Galton's Law that it only applies to the average inheritance of masses of people and not to the individual, and this was clearly recognised by Galton himself, for he says: "Though one half of every child may be said to be derived from either parent, yet he may receive a heritage from a distant progenitor that neither of his parents possessed as personal

characteristics." Again, speaking of particulate inheritance he remarks: "All living beings are individuals in one aspect, composite in another. We seem to inherit, bit by bit, this element from one progenitor, that from another; in the process of transmission by inheritance, elements derived from the same ancestor are apt to appear in large groups, just as if they had clung together in the pre-embryonic stage, as perhaps they did." They form what is well expressed by the word "traits"—traits of feature and character. The offspring of parents possess a mosaic of inheritance bearing usually more or less similarity, yet the mosaics of characters, whether bodily or mental, are not in any way identical except in the case of identical twins. Probably nothing has shown more conclusively the dominant influence of heredity on character than Galton's inquiries on the history of twins. He found that similar twins living in a different environment nevertheless remained similar in temperament and character, while dissimilar twins brought up and living in the same environment remained dissimilar. These dissimilar twins, however, were the product of two separate ova, whereas identical or similar twins were the result of fertilisation of one ovum containing two germs of identical substance; which proves conclusively how untrue is the theory that all persons are born with equal mental capacities, the differences of development being due to education.

The Mendelian doctrine of heredity is proved

as regards segregation of unit characters in the human subject; but even Bateson (the champion of Mendelism) does not claim that Mendelian proportions have been proved as regards human characters except in the case of eye-colour and certain abnormalities and defects. He himself admits that as regards mental characters the factorial analysis is so complex that proof is still wanting.

Primitive Emotions and Instincts independent of Education and Environment.—In considering the inborn potentiality of the child's mind, it is necessary to recognise that there is a pre-organised nervous mechanism in the brain and spinal cord which acts independently of education and social environment. This pre-organised nervous mechanism presides over the instincts and emotions essential for the preservation of the individual and of the species. The instincts are of the same nature in man as in animals, and the primitive emotions are similar in character, but are of a lower order in the latter and incapable of developing into passions or sentiments; they differ in their mode of expression owing to the more refined nature of the human body and complexity of its movements. The desires, the associated instincts, the primitive emotions and passions are common to all human beings whether primitive savages or cultured races. They are best observed in children, savages, and feeble-minded adults in whom the highest control is either undeveloped or imperfectly developed. Whereas the individual ex-

perience of every other animal is almost entirely lost when it dies, man, by virtue of his acquirement of speech and the creative use of the hand in perpetuating his thoughts, feelings, and ideals, has slowly built up a great social heritage. The brain of the individual is the receptor of this social mind, which printed language (especially) and other creations of man's hand have placed at the disposal of all mankind.

The Social Mind.—What would happen to the child if it were deprived of this social inheritance? It is said that one of the Pharaohs made the experiment of causing a child to be brought up without its hearing any spoken language, in order to see what language it would speak. Hearing no language it spoke no language. Again, in 1840 a wild man was found in the forests in Germany; he spoke no language, but when brought to a town he learnt German.

Let us imagine for the sake then of explaining the important part played by this social heritage on the individual mind, what would happen if man were suddenly deprived of this heritage, which, as Huxley says, has "placed him as upon a mountain top, far above the level of his humble fellows and transported his grosser nature by reflecting here and there a ray from the infinite source of truth." Supposing another flood came, and instead of Noah and his family having been preserved with the animals, only two infants (male and female) survived by some such agency as the mythical she-wolf that suckled Romulus and Remus, the founders of ancient Rome: and

let us imagine that they grew up and became the progenitors of a new race. Deprived of a social heritage, they would have had to start building it up anew, but probably this would have taken countless ages, for there is no proof that the innate potential brain power of these two children of modern civilised man to create a social heritage would be immeasurably superior or even much superior to the reindeer men who lived in Europe and left their handwork in caves ages ago. According to Ray Lankester, these men had as largely developed brains as modern men. The man who made those drawings of deer with his rude instruments was a great artist, and the man who first discovered how to forge metal into an instrument for the use of the hand instead of a chipped flint was potentially as great a genius as Galileo or Newton.

The life of two such human beings without a social environment would at first depend almost entirely upon the fixed, stable, and pre-organised characters of the species and sex, which would determine by an untaught aptitude the instinctive actions and behaviour necessary for the preservation of the individual and the species, with primitive emotional states of feeling and their special characteristic manifestations. Hence might be displayed fear and anger, joy and sorrow, wonder and surprise, play and self-display, self-abasement, curiosity, taste, and disgust.

In common with all human beings, including savages, our imagined pair would exhibit not only the primitive emotions, but sentiments and

passions in their elemental form, such as love and hatred, pride and contempt, suspicion, vengeance, grief, and despair, displayed by attitude, gesture, and facial expression, accompanied by the utterance of inarticulate vocal sounds, by crying and laughing, and signs of pain and pleasure. Such expressions of the feelings constitute a universal language understood by all human beings, because common to all human beings.

At the proper season, an attraction of the two sexes necessary for the preservation of the species would occur, for this sexual attraction which we term love possesses a universal language. In the normal conditions of life it is both a physiological and psychological process; it is the fountain head of the emotions and passions, stronger even than the fear of death. Love, though mute, speaks more eloquently by signs than any spoken language.

When pure and undefiled there is nothing nobler or more ennobling than love and parentage, and it is a sign of racial degeneracy when desire for parentage, filial piety, and pride of family show progressive waning. The love of the parents for their offspring and the converse is a sacred vital instinct. There is no facial expression significant of the feeling associated with this instinct except that of a calm and contented happiness, and, as Mr. Shand has pointed out, a glint in the eye, a tendency to smile, and the gesture of contact. These characters of expression of the tender emotion by the mother

for her infant are well exemplified in the Madonna and Child by Correggio. The yearning for this feeling is present in every normal unmarried woman, and is a potent force, which, fortunately, intellectuality cannot wholly supplant; yet do we not find this instinct to beget, protect, and cherish their offspring associated with a primitive emotion, the "tender emotion," in all the higher animals? From this biological spring, then, must have arisen the human sentiments of love, sympathy, pity, generosity, gratitude, true benevolence, and altruism of every kind; it is therefore easy to understand why the pictures of the Madonna and Child have appealed for ages to the faith and devotion of countless millions as a vital and sacred symbolic truth. We must therefore regard æsthetic and moral feeling as having an evolutional biological basis founded on the preservation of the individual and the species.

The inborn raw material of character is a complex dependent largely upon the instinctive animal characters of the species, as well as upon sexual, racial, and family ancestral characters; it is obvious that the inborn physiological characters of the species and sex are fixed and stable, and that they are the stem of the tree of life, on which has been grafted the characters of race and family progenitors, these being of later evolution, and therefore more capable of variation and mutation.

The future of the race, born of these two hypothetical children, would depend upon whether they were well-born—and by well-born I do

not necessarily mean of wealthy or aristocratic parents, but of parents possessed of healthy minds in healthy bodies, coming from good stocks of broad-chested sires and deep-bosomed mothers; endowed with courage, honesty, and common sense, which is the inborn aptitude of profiting by experience to do the right thing at the right moment. With such a heritage these two human beings, with the instincts for the preservation of the individual and the species, would possess as inborn qualities tendencies which would be productive of a virile stock endowed with superior energy, sagacity, and racial temperament, thus enabling their descendants to have a great advantage over primitive races possessed of a language and a limited social heritage. There would be an inborn tendency to artistic feeling and speech, derived from progenitors, which under favourable conditions could find expression. There might be an inborn tendency to the instinct of curiosity which would lead them to observe and reason on natural phenomena, and thereby learn to obtain fire and to make rude weapons. If their parents were right-handed, as in all probability they were, they would use the right hand in preference; that is to say, the left half of the brain would be the active partner, and predominate in voluntary movements of the hand as an instrument of the mind and the mind's instructor.

It would be safe to assume that prior to the acquisition of articulate speech and language this new race of beings would at first only be able to

communicate with one another by gesture language ; then some creative mind would employ articulate sounds to supplement the primitive gesture language as a means of communicating ideas, and correspondingly would arise the dawn of a higher intellectual development and abstract thought and reasoning, because thought in all the higher mental processes cannot be carried on without the aid of language. Then, as language by graphic signs and articulate speech progressed together, simultaneously supporting each other in the development of the higher mental faculties that differentiate the brute from the savage and the savage from the civilised human being, so the social heritage—the Universal Mind—would expand and increase. Man, instead of thinking by associating concrete images, would now carry on the processes of thought and memory by means of words heard and seen (symbols), in the form of spoken, written, and printed language.

How great a part language has played in the development of the mind can be gathered by a little consideration of the fact that individual human experience would be almost entirely lost by the cessation of every individual life, without language. Moreover, completely developed languages, when studied from the point of view of their evolution, show that they are stamped with the print of unconscious labour that has been fashioning them in the long procession of ages. Reflection upon new words coined in our own time proves that the evolution of language exhibits an abstract and brief chronicle of the

history and progress of the race, and it constitutes the Social Mind, embodying the record of past experience which each later individual of the race can utilise through his senses and his brain. We know that the offspring from a savage tribe in Africa, brought up among cultured people, can, by imitation, through his senses utilise this social heritage ; he fails, however, individually and collectively, to initiate new ideas and to *add* to the social inheritance of mankind. The millions of negroes in America have added little or nothing to the sum of human knowledge since their emancipation from slavery.

The Brain a Transformer and Accumulator of Neural Energy from Cosmic Energy.—You may ask : Will not the brain be affected in its growth by deprivation of the stimulus of the social heritage ? There are certain facts which point to its not being affected in its growth and structural development. First of all we must look upon the whole nervous system, and particularly the brain which forms the greater part of its bulk, as possessing the function of transforming cosmic energy into neural energy and storing it up as nerve potential. This function would not suffer in the least by the deprivation of the social heritage built up by language. Moreover, the fact that the wild man found in the forest in Germany was able to learn German shows that the latent capacity was there in spite of the fact that he had never since childhood heard spoken language. So also does the history of Marie Heurtin, the congenital blind deaf mute,

whose education was not begun till she was ten years of age (*vide* pp. 107, 108). When I speak of the transformation of cosmic into neural energy I mean that a nerve current is a specific molecular vibration travelling along the nerve at the rate of about 30 yards a second; it is not therefore an electrical current, although it produces an electrical disturbance in the tissue involved. The effect on the mind produced by an external stimulus we say is due to the nature of the stimulus; that is true, but it is also due to the specific function of the neural systems of peripheral receptor, transmitter, and central perceptor in the brain. For the same stimulus will give rise to different sensations, according to the different special sense organs stimulated. Thus if an interrupted electrical current be applied to the tongue so as to stimulate the gustatory nerve, taste is experienced; if the eye or optic nerve, a bright light; and the auditory nerve excited gives rise to the sensation of sound; and the skin, a sensation of painful vibration. Each neural system, then, has a specific energy of its own to transform this electrical energy into specific neural energy and to store up memories of the same in the brain.

THE RAW MATERIAL OF CHARACTER IN RELATION TO HEREDITY

The convolutional pattern of the brain—the organ of mind—is no haphazard affair, but is dependent upon the inheritance from progenitors of similarities in the fissures and folds, just as we know that in every face may be found the features of ancestors, so in every character may reappear the character of ancestors. Galton's statistical inquiry into good and bad tempers shows that one influence tends to mix good and bad tempers in a family at haphazard; another tends to assimilate them, or that they should all be good or all be bad; a third set tends to divide families into contracted portions. This pedigree (fig. 5) shows in the third generation a sorting out or segregation of good and bad tempers, as the children resembled the father and mother respectively.

"Like tends to beget like," and I cannot do better to show how this applies to bodily and mental characters than by referring to the picture drawn by Oliver Wendell Holmes of the two types of New England College youths in the preface to the novel "Elsie Venner." "The

first type of youth is the common country boy whose race has been bred to bodily labour.

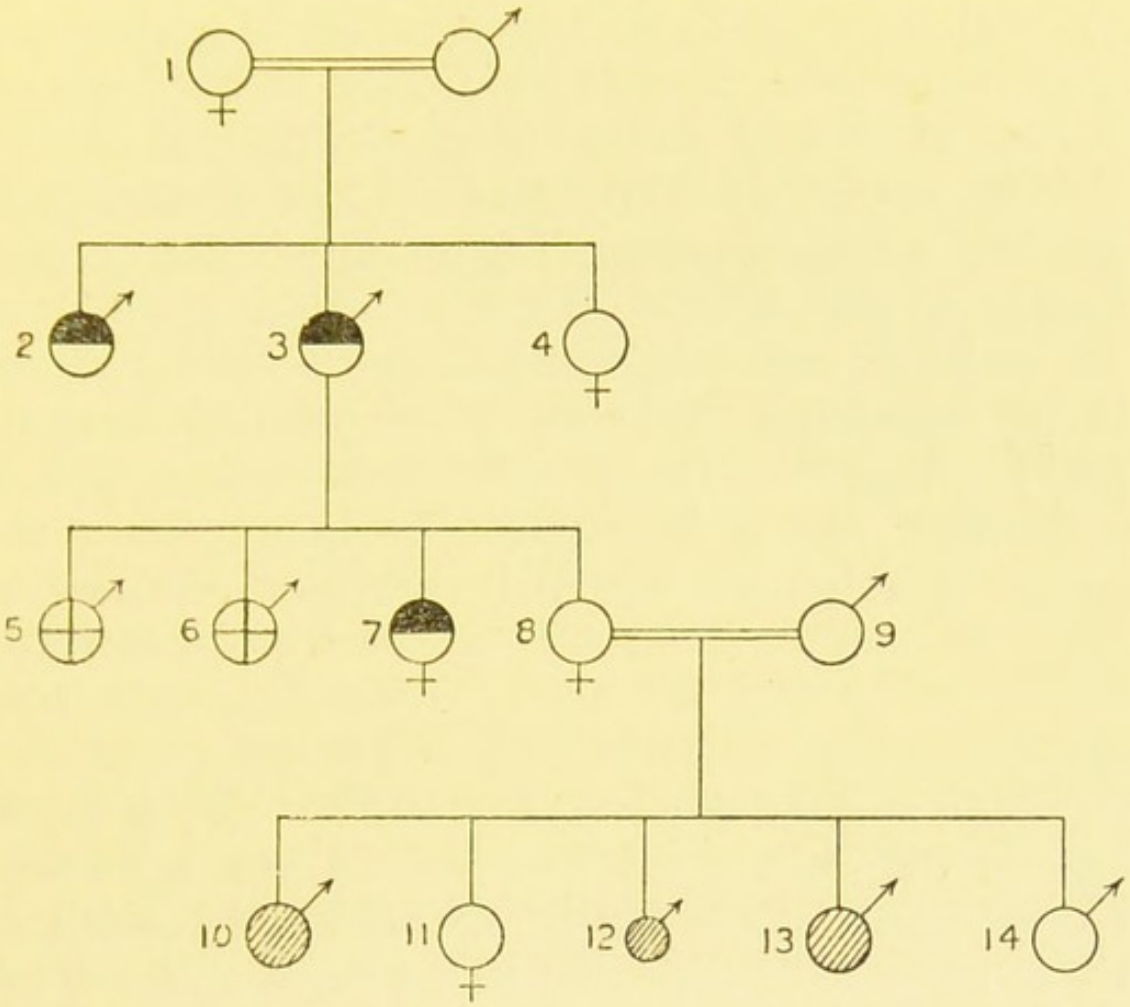


FIG. 5.—The above pedigree shows the transmission of insanity, immorality, and violent temper.

No. 1, the grandmother was immoral. Of her children, No. 2, an engine-driver, was "a man of violent temper who smashed things on a wholesale scale at home. He died with the delusion that he was going to heaven on the footplate of an engine." No. 3 was also a man with a violent temper, dangerous to himself and others, who eventually died from general paralysis. The daughter, No. 4, was criminally immoral; she had an illegitimate child, but no children by her marriage. The children of No. 3 are as follows: Nos. 5 and 6, both men with violent tempers, drunken and immoral; No. 7, a daughter, criminally immoral, who eventually was detained in Bethlem for a period. No. 8 is a woman with a very violent temper, smashes things, and has attacked her husband with a poker, etc.; has tried to commit suicide by poison and once by hanging; gushes to every man, but repels her husband. The husband asks, "Is she mad, or bad, or both?" The husband is a healthy, robust man, who comes from a good healthy stock. The children were five in number; two survive (Nos. 11 and 14), and these fortunately resemble the father; they are healthy, robust, and energetic. The first-born, No. 10, was a boy resembling his mother; he was nervous, reserved, lacked mental energy, and was prone to somnambulism and night-terrors which existed in his mother's family; he died under an operation at the age of 12. No. 12 was the image of his father, but died from measles when 10 months old. No. 13 was nervous and resembled his mother; at 19 months he died from whooping-cough.

Nature has adapted the family organisation to the kind of life it has led. The hands and feet by constant use have got more than their share of development: the organs of thought and expression less than their share. The finer instincts are latent and must be developed.

"A youth of this kind is raw material in process of elaboration. You must not expect much of any such. Many of them have force of will and character and become distinguished in practical life, but few of them ever become great scholars. The youth of the other type is a scholar, and a large proportion of cases the son of scholars or scholarly persons. There are races of scholars among us in which aptitude for learning and all the marks of it are congenital and hereditary. Their names are always on some college catalogue or other. They break out every generation or two in some learned labour which calls them up after they seem to have died out. At last some newer name takes their place it may be, but you inquire a little and you find it is the blood of the Edwardes or the Channings or the Ellerys or some of the old historic scholars disguised under the altered name of a female descendant."

But Wendell Holmes goes on to point out what is very true that the race of the hereditary scholar is apt to lose some of its animal vigour, and he is then unable to successfully compete with the scholar who comes by Nature's special grace from an unworn stock of broad-chested sires and deep-bosomed mothers; for animal

vigour and sound digestive and respiratory organs are as important for success in life as a fine brain, because the organ of mind can only recuperate and store neural energy when healthy bodily functions are maintained. It is a prevalent but mistaken belief, as Galton points out, that men of genius are commonly puny in body and dyspeptic or of poor constitution. True it is that a great number of men of genius occur to one's mind who were sufferers from physical ailments ; many of them were poets, and the names of Heine and Pope are recalled ; but, as Galton says, in the majority of instances the biographies of the heroes of history prove the contrary.

It is readily understood that a healthy body is necessary for will power and mental energy, without which the genius of imagination can never attain its full fruition. Nevertheless, history and biography proclaim that the genius of imagination of the poet, of the prophet, of the artist, of the philosopher, and the lust of action of the world's great leaders of men have been so frequently associated directly and indirectly with epilepsy, insanity, or a neuropathic tendency that Dryden's lines are apt to be regarded as a truism :

> " Great wit to madness sure is near allied,
> And thin partitions do their bounds divide."

It is a great mistake, however, to suppose that a stock which does not show pathological mental instability in the form of epilepsy or insanity cannot therefore produce genius.

It is, however, certain that little good can come out of a stock in which there is a marked tendency in its members to germinal mental deficiency; it is otherwise in the case of mental instability, for that very instability of a stock which produces a mutation from the "honorable ordinary" may lead to the genesis of a constructive imagination which, combined with a courageous and even fanatical temperament, disregards traditions, prejudices, and social usages, kindles a new fire in the hearts of men, and thereby arouses new hopes, sentiments, and ideas in races. Thus new faiths and religions were begotten by visionaries, such as the Apostle Paul, Mahomet, Martin Luther, and Emanuel Swedenborg.

Still if a nation in order to progress must have an admixture of mental instability in the form of imaginative genius and insanity, a thin streak of it is sufficient; for that nation will be the most virile which can breed from the greatest number of individuals endowed with the attributes of civic worth, courage, honesty, and common sense.

Galton points out in his work on Hereditary Genius that the children of gifted parents are more precocious as a rule than their parents, and this conforms to what we know in respect to inheritance of certain diseases, especially insanity, in which "anticipation" or "antedating" tends to occur. "Anticipation" or "antedating" implies a tendency to the occurrence of the onset of disease in the offspring at

an earlier age than it commenced in the parent (fig. 5A). There is a tendency to "antedating," then, (according to Galton) in intellectuality, and

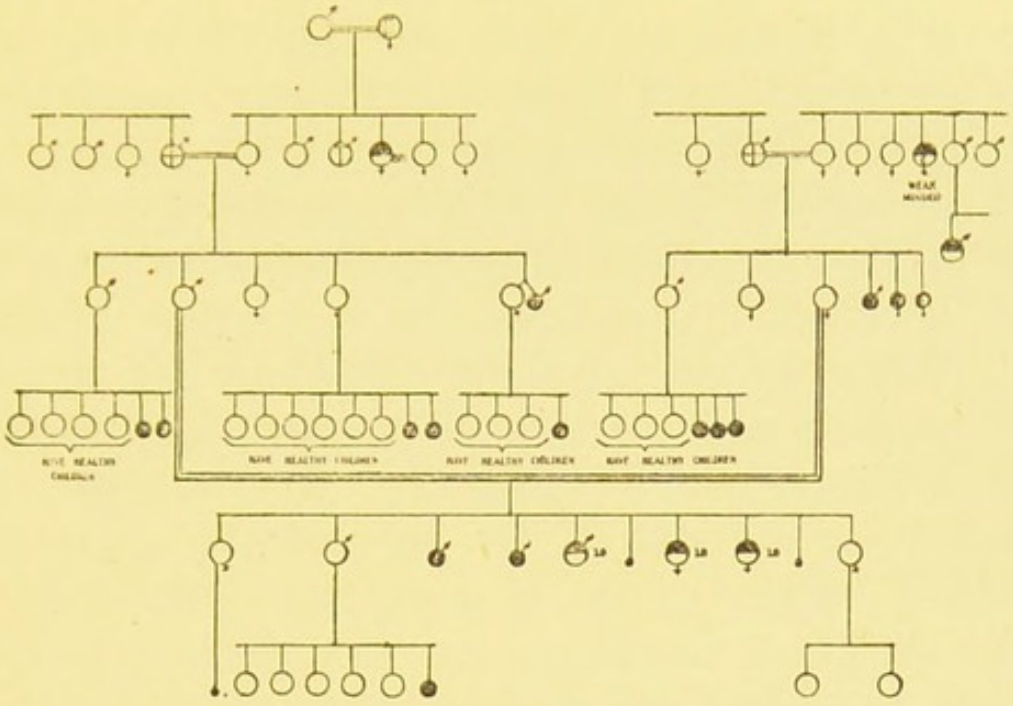


FIG. 5A.—Pedigree of five generations relating to three patients, two sisters and a brother, admitted to Hanwell suffering with Dementia praecox; the age of onset of insanity in all three was approximately eighteen; they are still in the asylum. All the other matings have led to the production of healthy children, and it is probable that with the elimination by "anticipation" of the three unsound members the stock under ordinary favourable conditions may return to the normal average.

The eldest daughter married; had only one miscarriage. The eldest son has six children, five living, some grown up and normal. The youngest daughter married and has two normal children aged four and two years. The father and mother were both life abstainers. The father's confraternity and their offspring are quite normal, but on his father's side there is a history of drink and on his mother's collateral insanity and epilepsy in the grandmother. On the mother's side in her generation there is no insanity or epilepsy, but her father was an alcoholic, and on her mother's side there was collateral insanity. It seems that the mating of these two potentially unsound stocks intensified the neuropathic taint which revealed itself in an active form in these cases of adolescent dementia. Half-black circles, insane; circles in quadrants, alcoholic; small black circles, premature births or died in infancy.

the result is not always a fortunate one; for the clever child of gifted parents is often pushed forward unduly and his physical and mental

constitution seriously injured, the infant prodigy is ruined in physical health or by mental breakdown in adolescence, and thus abruptly closes the chapter of a gifted inheritance. Prosper Lucas in his great work on Heredity remarks, that as giants and dwarfs are rarely prolific, so men of prodigiously great or small intellectual powers may be expected to be unfertile. Galton admits that a surprising number of the ablest men have left no descendants, but while thinking that there is an inherent tendency to barrenness in men and women of genius, he considers that a considerable number of instances of isolated genius should be ascribed to a number of other causes than to a germinal defect.

A striking instance of hereditary musical genius passing through generation after generation is the Bach family, which is thus described by Galton: "The Bachs were a musical family comprising a vast number of individuals and extending through eight generations. Musical talent first showed itself in a Bach in 1550; it culminated in Sebastian, a transcendent musical genius (1685–1750). He was very precocious, and arrived at the full maturity of his powers at the age of 22. He was a good husband, father, friend, and citizen. The last known member of the Bach family was Regina Susanna, who was alive in 1800, but in indigent circumstances. There were more than twenty eminent musicians among the Bachs, and the biographical collection of musicians gives the lives of no less than fifty-seven of them.

The following pedigree (fig. 6) illustrates the transmission of the artistic, æsthetic temperament, as shown by a high degree of musical and literary ability, etc., combined with very marked mental instability, through five generations.

Another remarkable pedigree (*vide* fig. 7) is the Darwin-Galton-Wedgwood family, and it is of interest here to remark that Erasmus Darwin anticipated many of the theories of evolution

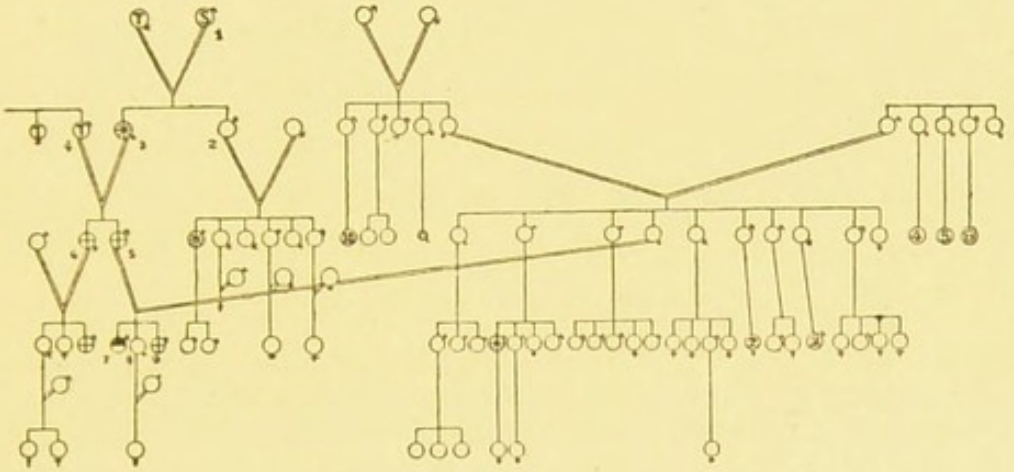


FIG. 6.

Half black circle, *insanity*; circles in quadrants, *alcoholism*; circles in octants, *genius*. T, tuberculosis. S, suicide. 1, alcoholic and suicide. 2, an able musician and composer. 3, musical genius and composer. 4, confirmed alcoholic; 5, musical genius and well-known composer. 6, alcoholic. 7, aged 25, insane, congenitally deficient, emotional, impulsive, passionately fond of music. 8, a gifted soprano. 9, alcoholic, moral degenerate, marked musical ability.

and heredity subsequently elaborated and demonstrated by his illustrious grandsons Charles Darwin and Francis Galton. But for every instance in which genius can be traced to hereditary influence an equally great name can be offered in which the hereditary influence cannot be shown, and genius often springs up in a stock we know not how or why, and with meteor-like flash it disappears. How far the

epoch makes a man of genius or a man of genius makes the epoch it is difficult to say.

Dr. Maudsley has remarked that many a Napoleon has died an inglorious death upon the

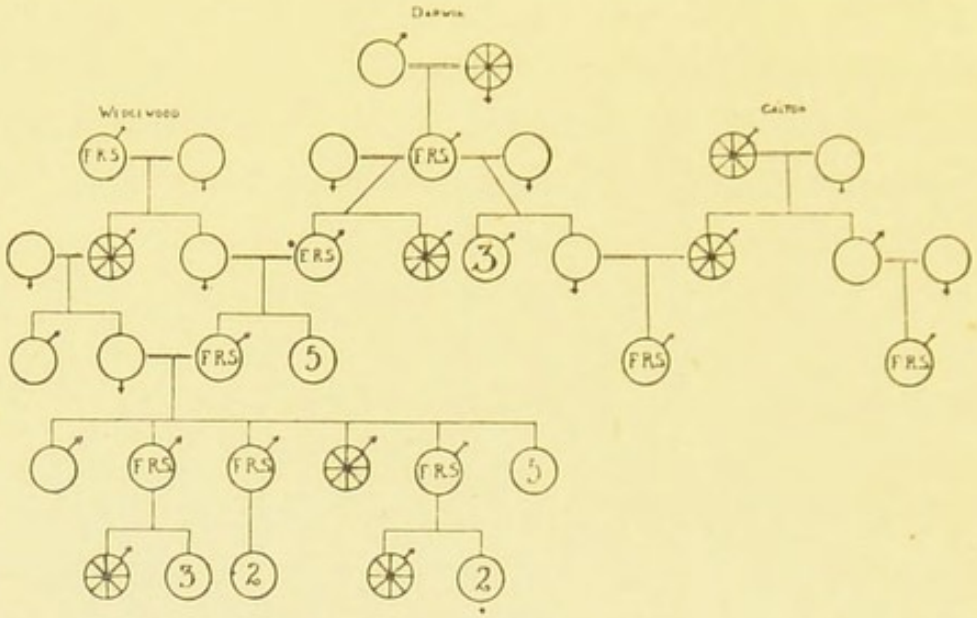


Fig. 7. Pedigree chart of the Darwin, Galton, Wedgwood families abridged and slightly modified from Whetham. The Darwin family is shown connected by marriage with the Wedgwood and Galton families. The genius of the Darwin family was first exhibited by Erasmus Darwin, whose mother is said to have been a very learned woman. The son of Erasmus, Robert Waring, married into the Wedgwood family—the illustrious Charles Darwin was his son. Violetta, daughter of Erasmus by his second wife, married into the Galton family, and the illustrious Francis Galton was her son. It will thus be seen that Erasmus Darwin had two most illustrious grandsons. The chart further shows that each family produced other men of great ability. The circles in octants indicate great ability. Besides, in the three families there are altogether eight other men whose additions to natural knowledge gained for them the Fellowship of the Royal Society.

scaffold. Genius belongs to no social order or class, nor can we explain in the majority of cases whence it comes. The part that chance plays by a happy and harmonious combination

of germs in the production of genius is shown by the fact that the most outstanding figure of the Renaissance period — Leonardo da Vinci (1452–1516) — sculptor, painter, architect, en-

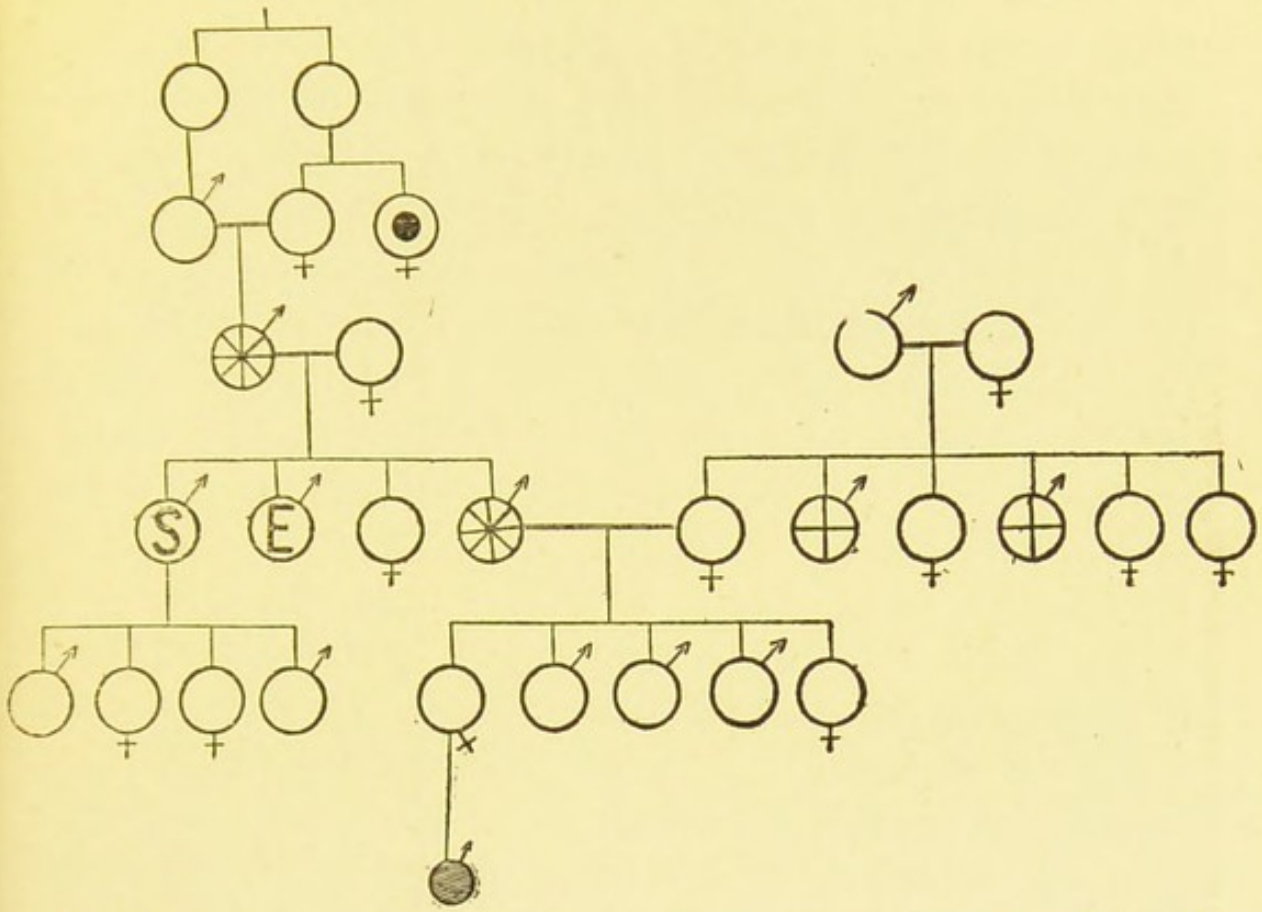


Fig. 8.—A pedigree, illustrating the marriage of first cousins. A genius was the result; he married a healthy woman, and their family consisted of an eldest son, a suicide; a second son, an epileptic; a daughter, healthy, unmarried; and a son, a genius. This man was a genius, but had an extremely well-balanced mind; all his five children are healthy in spite of unsound collateral inheritance on both sides.

Circles with black centres—*physically unsound*. Circles in quadrants—*alcoholism*. Circles in octants—*genius*.

gineer, musician, philosopher, and universal genius, was the illegitimate son of a Florentine lawyer by a peasant woman. There was nothing in the history of the Da Vinci family to suggest constructive imagination; several generations of

lawyers of no remarkable note was the only family history pointing to intellectual ability. Moreover, the father of Leonardo had a large family born to him in wedlock; he was married to four women, and the last two gave birth to nine sons and two daughters. He had but one illegitimate child by the peasant woman, who subsequently married and had a family, none of whom attained any fame. The wonderful child, as remarkable for its beauty and strength as in its early manifestations of supreme mental endowments, was fortunately for posterity cherished by its father, who spared no opportunity which nurture and education could provide to develop this marvellous product of Nature. Would Leonardo have been what he was, had he not been born in the Renaissance period and had his wonderful talents developed by education? I could cite numbers of other illustrious men whose forbears had given no evidence of especial genius or talent, and who attained an everlasting place on the scroll of fame. Isaac Newton was the son of a small farmer proprietor of Cleethorpes; Michael Faraday the son of a blacksmith; Dalton, the son of a weaver; Turner (the painter), the son of a barber whose mother became insane, and from whom he probably inherited his eccentricity and imaginative genius. It is a probable fact that great men owe their genius in a great number of instances to their mother in whom it is latent. Abraham Lincoln himself said, "All I have and all I hope for I owe to my angel mother," and Goethe poetically

described his dual inheritance of body and mind in the following lines :

> Vom Vater hab' ich die Statur,
> Des Ernstes Lebens führen,
> Vom Mütterchen die Frohnatur,
> Und Lust zu fabulieren,

which freely translated means he resembled his father in stature and energy and his mother in his poetic imagination ; yet his son had none of his father's genius, and is spoken of as the son of the maid-servant. The greatest and best of all the Roman Emperors, Marcus Aurelius, says, "To the gods I am indebted for having good grandparents, good parents, a good sister, good teachers, good associates, good kinsmen and friends ; nearly everything good." Yet this man who practised the noble precepts he taught begot the infamous Commodus, one of the worst of the Roman Emperors. That Commodus was the son of Marcus Aurelius is shown by their physical resemblance, and not the son of a gladiator, as some have asserted, by the licentious Faustina the Empress. As it is stated that in spite of careful bringing up he early evinced depraved tastes, it is probable that he inherited his temperament from his mother, as he certainly did his bodily form from his father.

Although I do not possess precise statistical data, nevertheless I am convinced from personal observation that sons tend to take after their mothers more than their fathers, both in mental and physical characters, and the converse is true

that daughters tend to take after their fathers more than their mothers. Huxley, in one of his essays on Heredity, calls attention to this tendency. Still, this is nothing more than a tendency, for the physical and mental characters of the father's or the mother's stock may be prepotential, and the offspring of *both* sexes may show a greater likeness in either temperament or bodily characters or both combined to one of the parents or parental stocks. There is a common opinion, says Galton in "Hereditary Genius," that great men have remarkable mothers, but he considers that popular belief ascribes an undue and incredible share to maternal influences, and he remarks, "I account for the belief by the fact that great men have usually high moral natures and are affectionate and reverential, inasmuch as mere brain without heart is inefficient to attain eminence. Such men are naturally disposed to show extreme filial regard and to publish the good qualities of their mothers with exaggerated praise."

Perhaps one of the most striking facts of heredity in history is the Spanish Succession, of which an illustrative pedigree is given in fig. 9. It shows an hereditary neuropathic taint following a family for 350 years, and Ireland in his work "A Blot on the Brain" says: "Sometimes it passed over a generation and appeared in various forms and intensities as epilepsy, hypochondria, melancholy, mania, and imbecility till at length it extinguished the direct royal line of Spain." The tendency in the blood was, as you see, re-

inforced by close intermarriages with families of the same stock, and it is worthy of notice that

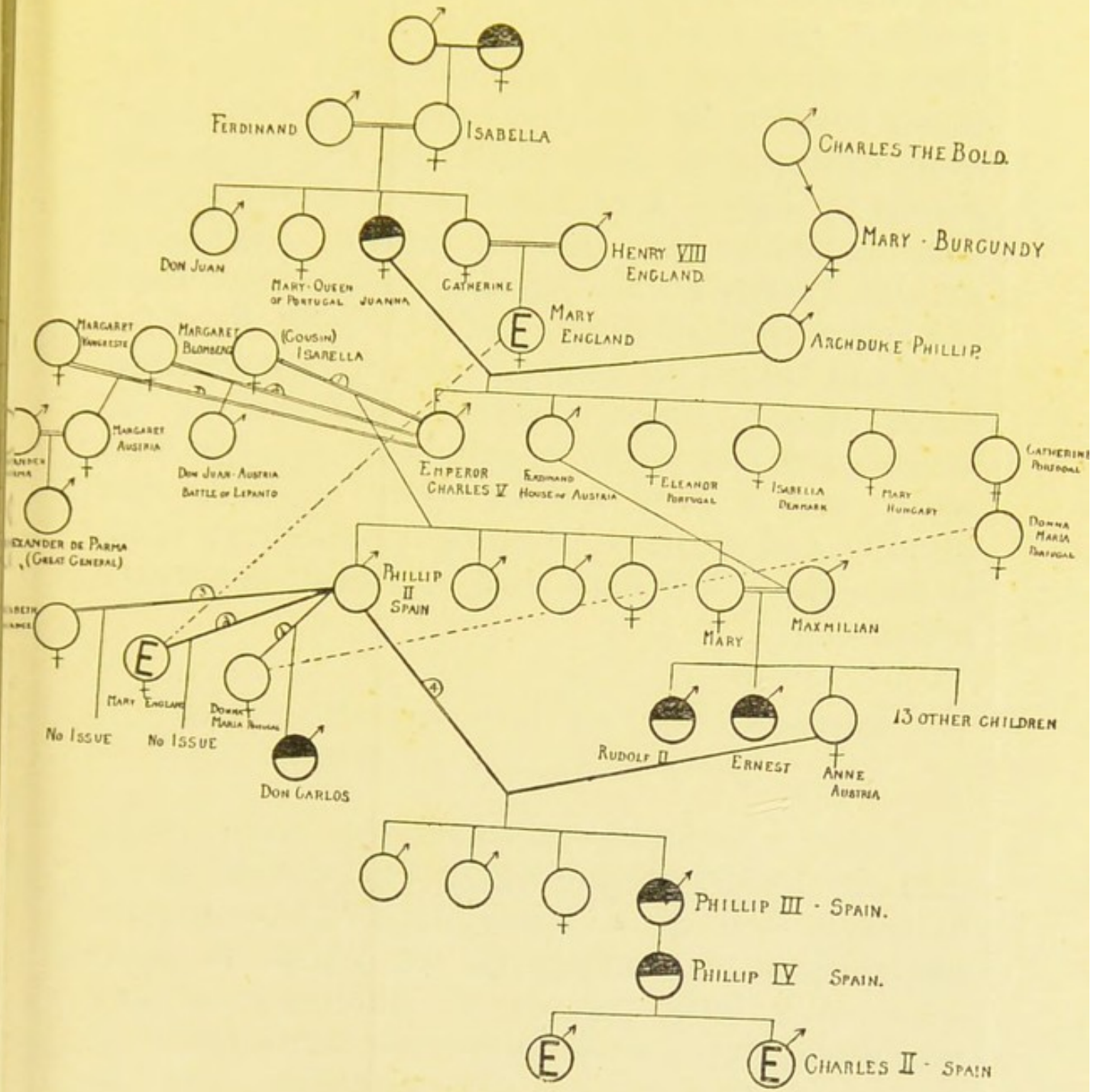


FIG. 9.

the house of Austria, with which the Spanish line was so often connected by marriage, had few members insane, and in the end threw off

the hereditary curse. "Such vigour as was in the first Spanish kings appeared in their illegitimate descendants, whereas those born in wedlock inherited the disease. In spite of the known ancestral taint a match with Spain was much coveted by the royal families of Europe; as an example we may recall the silly eagerness shown by James I. of England to marry his son Charles with the Infanta Maria. Whoever attends closely to history must know that there is a great deal in birth, but not birth fixed by laws and traced by heralds. A man who is well-made, strong, mentally gifted, and able to do much work and stand much strain must be well born, and a race sodden with epilepsy and insanity and scrofula, whatever its fictitious rank, is necessarily low born and in reality not worth preserving."

Inheritance of Pathological and Individual Characters

Special morphological characters have sprung into existence at one time or another in individuals and been transmitted for successive generations, extending, as we know, in some cases over long periods of time—*e.g.* among morphological peculiarities thus transmitted in successive generations for centuries may be mentioned the Hapsburg lip and the Bourbon nose. Another example is night-blindness, worked out by M. Cunier and the late Mr. Nettleship. This remarkable human pedigree

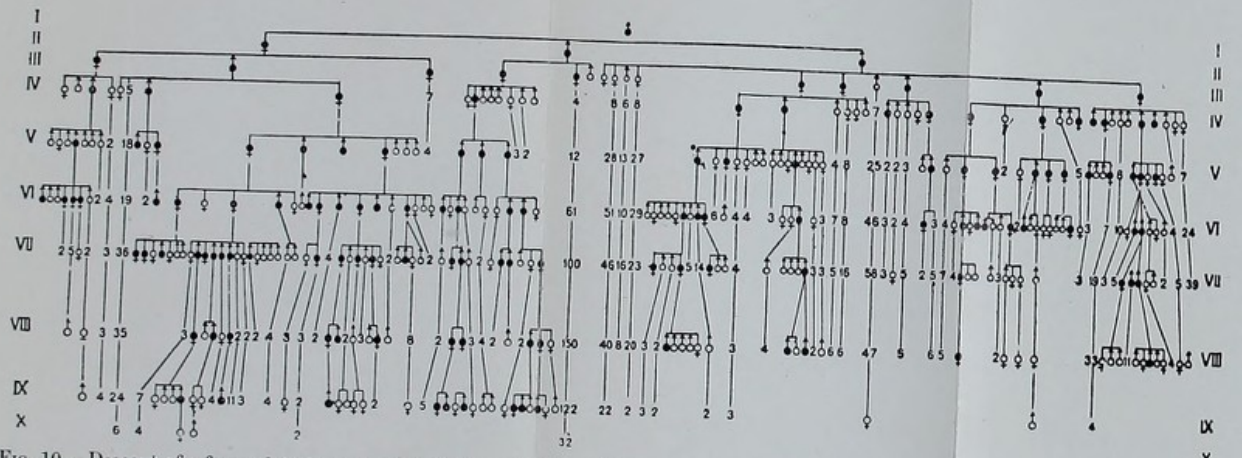


FIG. 10.—Descent of a form of stationary night-blindness (condensed from the chart published by Nettleship, based on Cunier's records with later additions). Only those families which contain affected members are here set out in detail. Black symbols show the night-blind individuals. The descent is always through the affected, showing the condition is due to a dominant factor.

(By kind permission of Prof. Bateson.)

comprises nearly 2,000 individuals, and extends back for ten generations (fig. 10). It commenced, so far as is known, with Jean Nougaret, born in 1637, and subsequently 135 descendants of this man were affected with a defective vision in a dull light. This defect would neither interfere with individual preservation nor propagation.

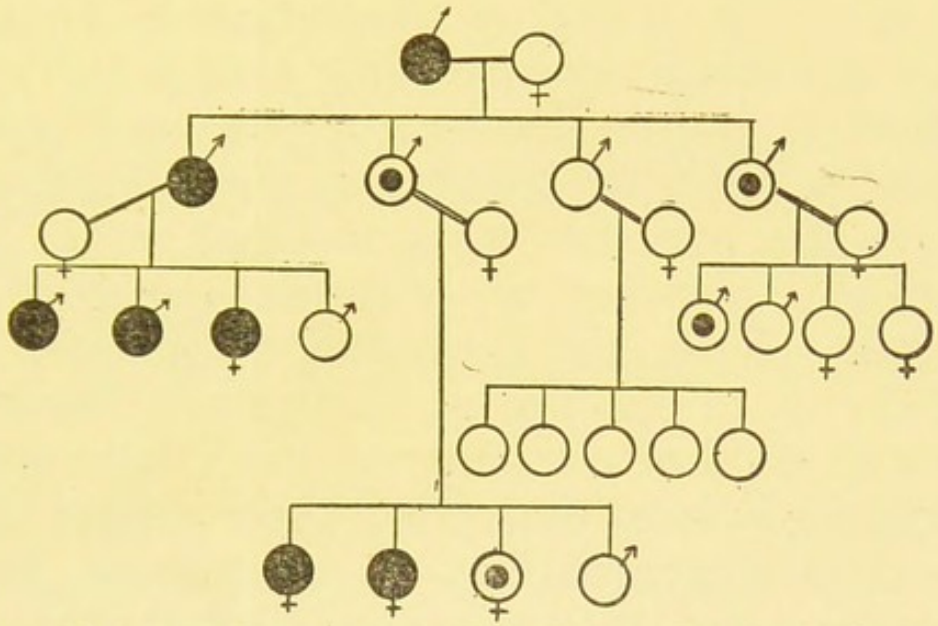


Fig. 11.—Pedigree showing poly-dactylism. Black circles indicate poly-dactylism, and circles with black centres partial poly-dactylism. The chart is very suggestive of Mendelian proportions ; the deformity being dominant. This pedigree of poly-dactylism has been constructed from an account given by Huxley, based upon observations made by Réaumur on the descendants of a Maltese named Gratio Kelleia, who had six fingers and six toes.

If defects, abnormalities, diseases, or predispositions to disease are continually arising by germinal variation, and if morphological defects, as we have seen in the case of congenital stationary night-blindness and other conditions (such as brachy-dactylism, poly-dactylism (fig. 11)), were not swamped out by dilution with normal stocks in

a series of generations, the whole race would become infected by such abnormalities. But there is always the tendency to regression toward the normal average of the species and of the race. The germ plasm of normal stocks is endowed with a dynamic, stable equilibrium which has been fixed for countless ages by evolution in the struggle for existence by sexual selection and survival of the fittest by adaptation to environment. By this means heredity acts as the great fly-wheel in the mechanism of the evolution of the species. Nature has, however, evolved other methods to prevent imperfections and poor mental and physical types from becoming perpetuated. Unmindful of the individual, and mindful only of the species, Nature has adopted a quicker method of weeding out and killing off the poor types ; it is by increasing their susceptibility in successive generations to ubiquitous germs or poisons—*e.g.* tubercle and alcohol (fig. 12). Another of Nature's methods is to intensify the disease or predisposition to disease and to bring it on at an earlier age and even at birth. This anticipation, or antedating, renders the unsound members of the stock less able to survive in the struggle for existence, because the disease seriously impairs their mental or physical powers. I use the "struggle for existence" in the sense of Malthus and of Darwin—the struggle for the necessaries of life among members of the same species, namely, the human struggle.

Not only would antedating and intensification of heritable disease—or predisposition to disease

—lead to diminished vital resistance to poisons or germs of disease, such as alcohol and tuberculosis, but, owing to lack of physical and mental ability to obtain the necessaries of life, vital resistance is still further diminished. The result is that the tendency is for the unsound members of the third or fourth generation of a mentally degenerate

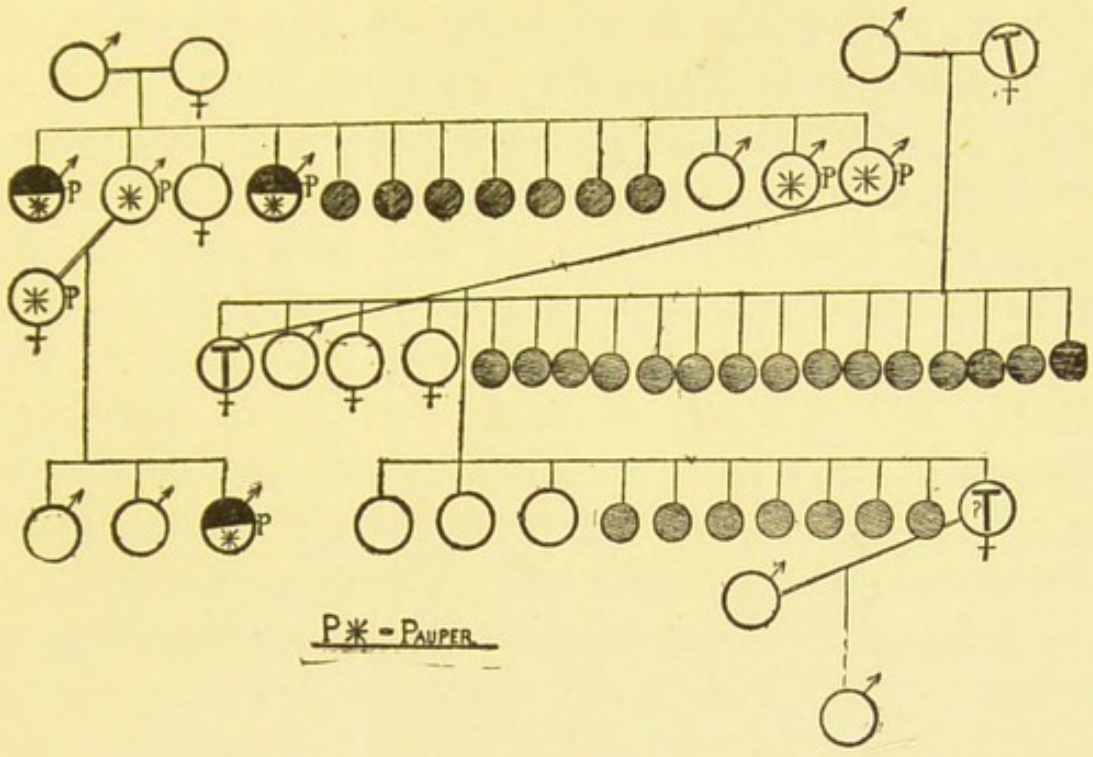


Fig. 12.—Pedigree showing marked fertility and great infant mortality in three successive generations.

Insanity, *half-black circles*; P, pauperism; T, tubercle; and death in early life, *smaller shaded circles.*

stock to die at a comparatively early age of some intercurrent disease, especially tuberculosis: propagation is thereby prevented. Again, the earlier the disease or defect appears, and the more intense its form, the less likely is marriage to occur and offspring to be born. Moreover, obvious inherited disease or congenital defect

(such as hare-lip, cleft palate, and predisposition by inheritance to feeble-mindedness, insanity, or epilepsy) interferes with marriage and parentage among the better classes; unfortunately it does not interfere with marriage or mating and parentage among the lowest, most fertile, least desirable classes of the population (fig. 13).

Sterility often accompanies marked mental deficiency, but there is no limit to the fertility of the higher-grade imbecile; in fact, the poorer the stock in mental and physical power and civic worth, the more prolific it is. The fertility is great, but the mortality of the offspring of the feeble-minded is proportionally great (*vide* fig. 12). Statistics of mentally defective children in the L.C.C. Schools show that owing to the high mortality rate in the families where there are defective children—that in spite of a much higher birth-rate—the number of offspring surviving is only a small fraction higher than the families of normals.

How and Why Individual Characters Arise

The two most important points to be considered in relation to *individual* characters are—firstly, how and why did they arise? and, secondly, having arisen, are they transmitted in successive generations according to Mendelian proportions and principles? In respect to the answer to the first question—how and why individual variations arise—every effect owns a

cause, and to term it spontaneous because we are unable to determine the cause with certainty is illogical and unscientific. Why should we deny the influence of environment, direct or indirect, upon the germ plasm as a cause of variations? In a pure-bred race there is no other cause to account for a germinal variation;

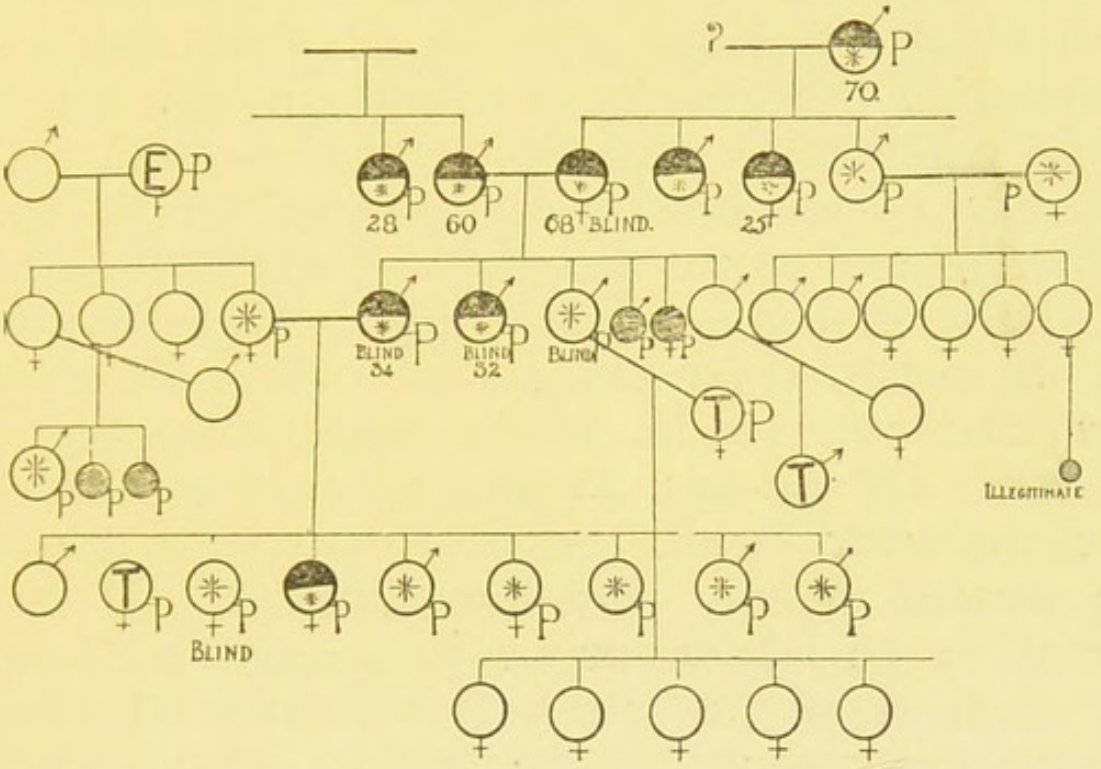


FIG. 13.—Pedigree showing transmission of insanity and blindness associated with pauperism and vagrancy.

Half-black circles, insanity; *circle with* E, epilepsy; *circles with* T, tuberculosis; *small shaded circles*, died young; *circles with* P *and star*, pauper. The number denotes the age at the time of first attack of insanity. Antedating is shown.

I admit that one important cause of variation of mental and bodily characters is a dissimilar dual racial inheritance. As regards the second question of Mendelian inheritance, when there is dual inheritance of dissimilar racial characters—*e.g.* when a black race is crossed with white—there is no proven evidence of Mendelism in

successive generations, but rather dilution or gradual swamping out, according to the proportional admixture of colour and no colour. Dr. Walker, The Interpretation of Fact in the Study of Heredity, "Science Progress," No. 30, October 1913, argues that Mendelism only applies to individual not racial characters. He states: "The alternative transmission of personal or individual variations must be of enormous advantage in the process of evolution. There is a rapid elimination of useless variations, and this rapidity of elimination is provided for by the inheritance of recent variations. Only 25 per cent of the second generation (from the introduction of the variation) possess gametes which all carry the character or in which some character is absent. Of the rest, 25 per cent will not carry the character at all, and in 50 per cent it will be present in only half the gametes." If the variation be advantageous to natural selection by survival of the fittest, it will thus be more easily preserved; if it be useless or injurious, it will be more readily and rapidly eliminated. Dr. Walker considers that the overwhelming proportion of characters which would be selected by eugenic methods would be recent variations—individual or personal characters, in fact.

The Neuropathic Inheritance

There are individuals born of sound stocks that no acquired conditions—*e.g.* drink, poisons engendered within the body or taken from without, head injuries, emotional shock, distress, and even

profound misery and destitution combined—can render insane. There are others, generally from a neuropathic stock, whose mental equilibrium may be disturbed by any one of these conditions,

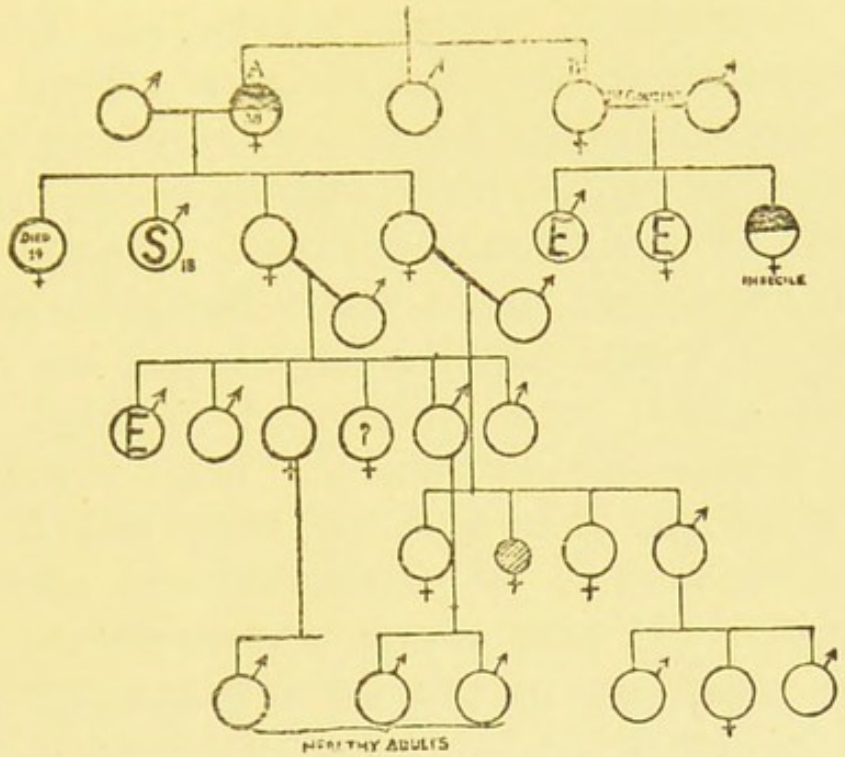


FIG. 14.—This pedigree shows the result of marriage of first cousins, in both of whom there was a latent neuropathic taint.

The family consisted of three individuals—two sisters, A and B, and an elder brother, who was married but had no family. B married a first cousin, and although neither of them were insane nor epileptic, yet they had two children epileptic and one a congenital imbecile; this terminated the stock on that side. That there was latent insanity was shown by the result of the marriage and the fact that a sister became insane. A, however, married into a healthy, virile stock; she became insane at the age of 38. Although living many years after she never recovered; the exciting cause was the death of a son by suicide (S) at the age of 18. There were two daughters who became mothers of families; the eldest son of one suffered with masked epilepsy, but no other evidence of neuropathy was shown in this generation. The taint seems to have disappeared, inasmuch as there are healthy, grown-up members of the fourth generation.

or very frequently, as my further observations will show, without any apparent cause except the conditions appertaining to the sexual functions and the instinct of reproduction in adolescence, the puerperium and the climacteric period.

A careful inquiry into the family histories of the progenitors and the collateral members of the ancestral stocks will in the great majority of cases show that a child born sound in mind and body is begotten by parents sound in mind and body themselves, whose stocks are free from any neuropathic or physical taint. Such a child with a good inheritance is very unlikely to suffer in later life with feeble-mindedness, epilepsy, insanity, or functional nervous disease. Occasionally, however, from some inexplicable cause parents of sound stocks may beget an idiot or imbecile child, or a child who in later life becomes insane or epileptic. But every effect owns a cause, although we may not have discovered it, and it is unscientific to speak of it as a sport. It may occur as a result of a latent morbid tendency in the germ plasm of the two stocks, as we know frequently happens in consanguineous marriages, when both stocks are *apparently* healthy, yet one or more of the offspring are mentally or physically unsound (fig. 14). A partially sound or unstable inborn mental constitution is usually inherited, and careful inquiry generally shows one of the parents or some other member of the parental stocks to have been mentally unsound or unstable. Occasionally, as fig. 15 shows, the unexpected happens in respect to inheritance. The child may give evidence of mental defect by being dull and backward in learning, or it may exhibit fits of uncontrollable temper without cause, or other signs of nervous irritability such as convulsive attacks, which may

be precursors of true epilepsy. If the child escapes any distinct morbid manifestation during childhood, there is a danger of its showing vicious tendencies later, or developing insanity or epilepsy

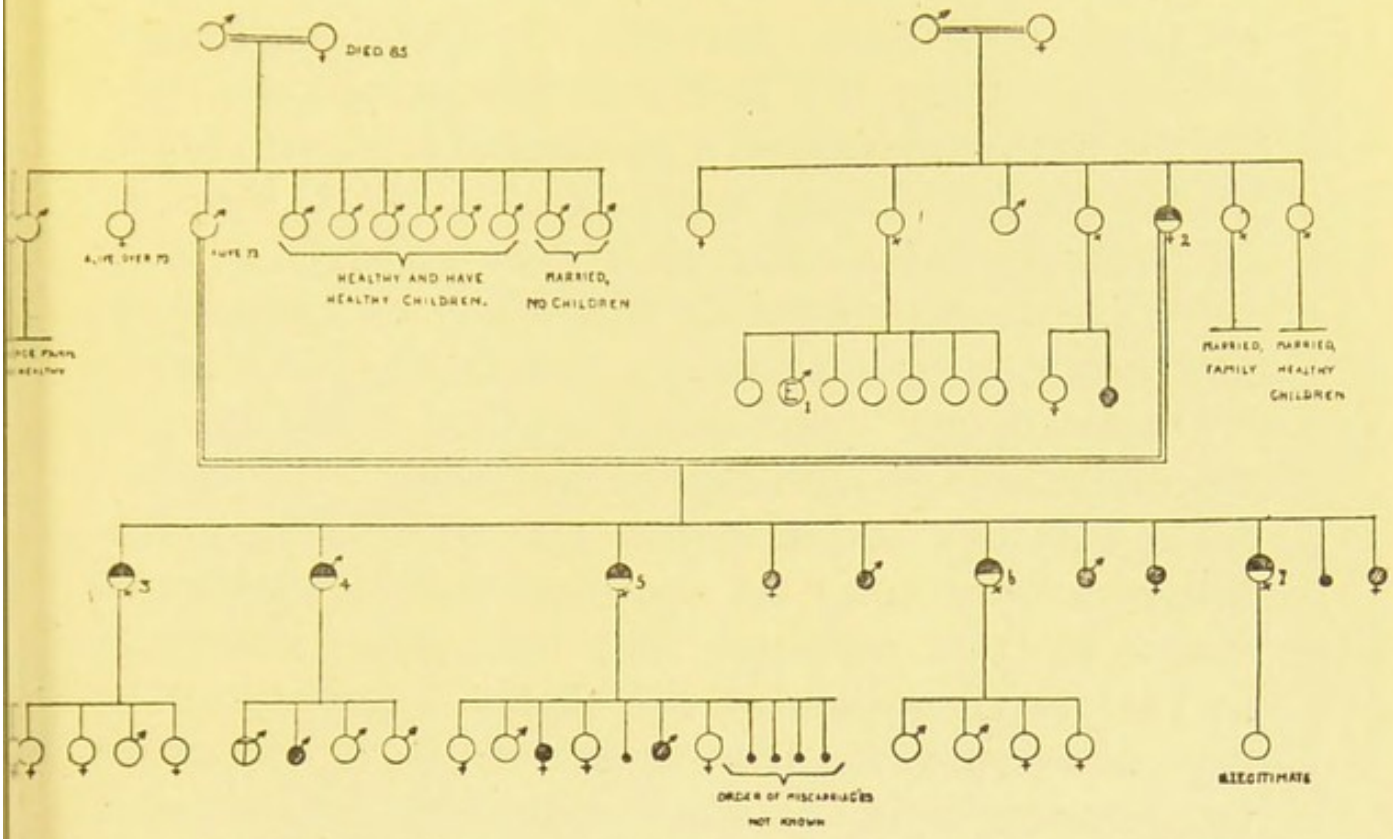


FIG. 15.—The above pedigree is of interest in showing healthy and intelligent progeny from a family in which all the surviving members are or have been insane.

The father of this family is living (aged 72) and his brothers and sisters are normal, and show longevity and fecundity, their children being healthy. On the mother's side there is no insanity noted, except in the case of (1) who commenced to have fits at the age of 4 ; these were severe, and continued until he died at the age of 38. (2) The mother ; she first became insane at the age of 38, at the time of the birth of (7) ; from this time until she was aged 54 she was in and out of asylums, but from 54 until the age of 66 she remained outside, when she was again admitted to the asylum and remained there until she died at the age of 72. (3) Is now in asylum. First certificated at the age of 45, but she had had three attacks previously, and these were associated with the birth of her children. Her four children, however (eldest 19, youngest 10), are healthy and above the average intelligence. (4) Is now in asylum. Admitted to the asylum at the age of 45, had previous attacks but was not certified. Cause stated to be worry due to desertion by his wife. His first child died aged 17 of consumption ; the second died, aged 3, from complication arising from rickets. The two other children are alive and healthy, aged 18 and 14 years respectively. (5) One attack of insanity at the age of 30, in asylum for three months following the birth of her fifth child. The surviving children are healthy, clever, and above the normal order of intelligence. (6) First attack at the age of 24, following birth of first child, two other attacks since associated with child-birth. Her eldest child, aged 11, had convulsions from 15 months to 3½ years of age, but is now healthy and clever. The remaining three children are bright and healthy. (7) First attack at age of 19, associated with birth of an illegitimate child. Had three attacks since and is now in asylum.

at the period of adolescence when the sexual instinct is aroused and new desires and passions stimulate the brain to a new activity.

Morel, who studied the question of the Neuropathic Inheritance more than fifty years ago, pointed out that nervous irritable weakness, which we term the neurotic temperament, may be the first evidence of a progressive degeneration in the stock. In an analysis of a large number of pedigrees of mental defective children I have been struck by a relative frequency of insanity in the grandparent, showing the truth of Morel's "Observations" published in his "Traité des dégénérescences de l'espèce humaine." Now, besides insanity and epilepsy the morbid neurotic temperament may be manifested in a variety of ways by the conduct and behaviour observed in various members of the stock. According to my observations, the signs of a neuropathic temperament in a stock may be self-centred narrow-mindedness in religious beliefs, fanaticism, mysticism, and an unwholesome contempt for traditional customs, social usages and morality, often combined with a selfish, self-seeking, vain spirit of spurious culture, or with a false sentimental altruism, or eccentricities of all kinds; such signs of degeneracy are often combined with talent and sometimes genius, but the brilliant intellectual qualities of a degenerate are invariably associated with either a lack of moral sense or of sound judgment and highest control.

An unsound stock may have successful men in the eyes of the world, but these may really

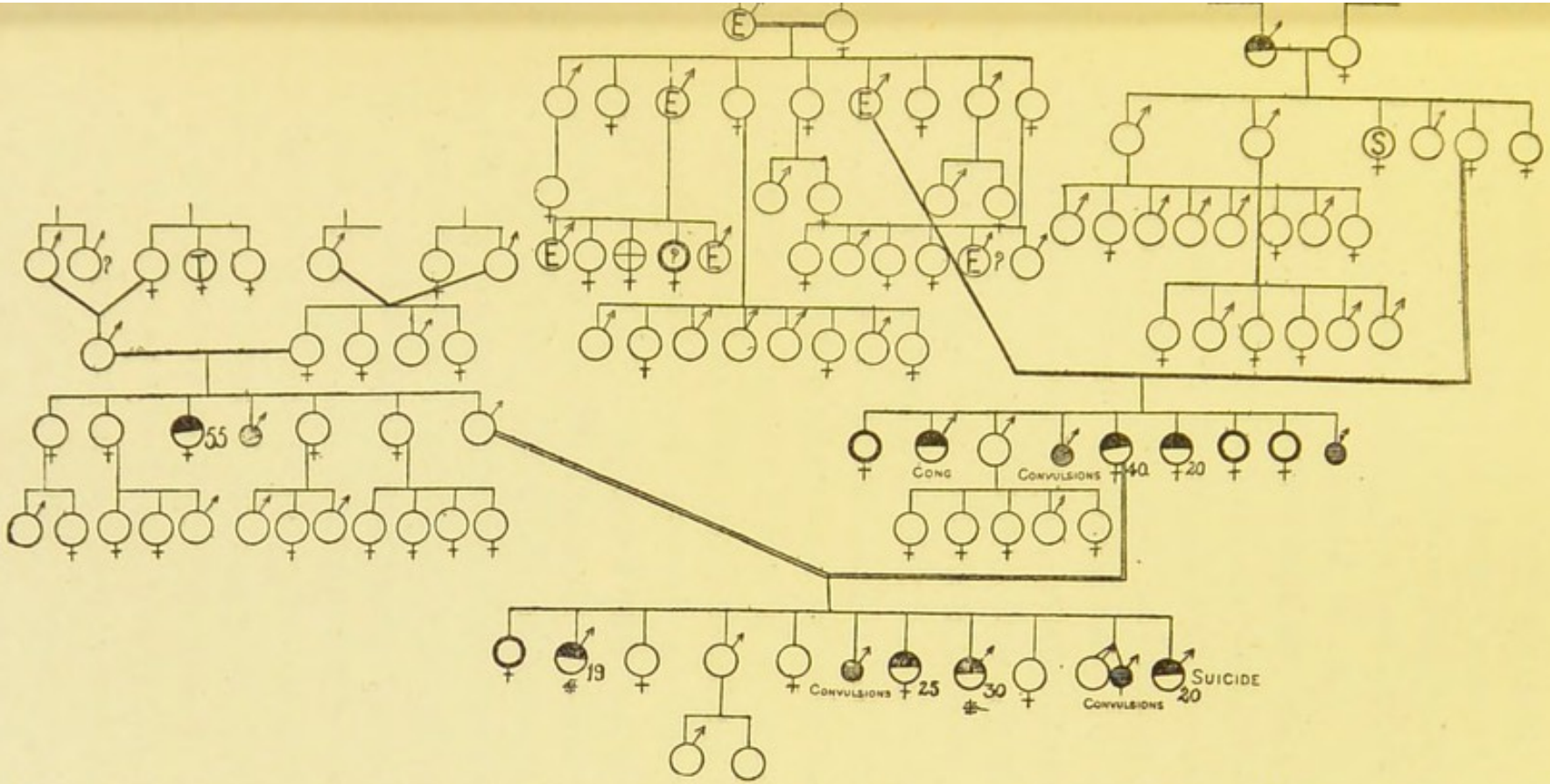


FIG. 16.—A very comprehensive and interesting pedigree obtained for me by Dr. Wilson White, showing the result of marriage of a nearly sound stock in which the temperament was, generally speaking, of the healthy, sanguine type with a neuropathic stock.

There was only one member insane at 55 in the healthy stock ; she was unmarried ; her four sisters, who were all married, had healthy grown-up children. The male was perfectly sane and healthy, of sanguine temperament ; married a woman descended from stocks in which there were many members suffering from epilepsy (E), and indeed her father and her grandfather suffered with it. On her mother's side there was suicide (S) of an aunt and insanity of a grandfather ; most of the members of this stock were of a brooding, melancholic temperament. The result of the mating of these two neuropathic stocks is shown. There were nine children—of whom three marked with dark black-rimmed circles suffered from some form of neurosis ; a male who died in early life of convulsions ; the patient's mother, who became insane at 40 ; a female who became insane at the age of 20 ; two females who also suffered with some form of neurosis ; lastly, a male who died in early infancy. The next generation, to which the patient belonged, shows the result of mating this stock with an almost healthy sound stock. We observe that four children became insane at the ages of 19, 25, 30, and 20 ; all had their first attack at a much earlier age than their mother ; one of them committed suicide, and two were found dead. This illustrates very well antedating and segregation of individual characters. The sound members of the family inherited their father's temperament, and the one member that married has quite healthy children ; this looks as if the unsound elements of this degenerate stock have been eliminated by intensification of the disease and anticipation, thus preventing propagation.

form the first step in the process of degeneration; for the avarice and moral guile which made them "pillars of society" may come out in the next generation as gross criminality or insanity.

The melancholic temperament is evidence of a neuropathic tendency. In collecting pedigrees I have often found that degeneracy and insanity in a stock are preceded by, or associated with, the existence of individuals possessing the melancholic, suspicious, hypochondriacal, despondent, gloomy, self-regarding temperament, and it is not uncommon for suicide of one or more members of the stock to occur in successive generations (fig. 16). The melancholic temperament may, however, be associated with unusual abilities and great power of attention and concentration. With these temperamental evidences of degeneracy of a stock may be hysteria, anxiety neurosis in the form of hypochondriasis (*malade imaginaire*), morbid fears or phobias such as claustrophobia (fear of closed spaces), agorophobia (fear of the market-place or crowds), neurasthenia, migraine, *petit mal*, or neuroses of an epileptic character, unrecognised, because not manifesting the characteristic fits of the major form of the disease—*e.g.* epilepsy may present the form of automatism and sudden criminal impulsiveness. Consequently, in making inquiry of a family history there are many possibilities of missing the inborn factor of a nervous disorder or mental derangement, even though a considerable amount of care and industry be expended,

combined with intelligent co-operation on the part of the friends.

Alcoholism, infective diseases, auto-intoxications, physical injury (especially head injuries and shocks), emotional shock, sexual excesses, and unnatural practices are too often wrongly assigned as the *sole* cause of nervous and mental disease, and the inborn factor of a neuropathic inheritance is neglected.

Sex in Relation to Character

With the dawn of the sexual passion at puberty a new and intense emotional phase of character occurs which, even when it is mature and developed, may not be shown in daily conversation, yet as a deep and silent undercurrent of consciousness and silent thought it is continually influencing the character and behaviour of both men and women in all grades of society.

But inasmuch as the sexual desire in the male is more insistent than in the female and persists much longer, it follows that, biologically speaking, it is incorrect to speak of equality of the sexes. Moreover, the desire is periodically continuous in the male; whereas in the female it is more or less in abeyance during gestation. The periodicity of sexual desire may be explained by hormones (excitants) produced by the passage into the circulating blood of internal secretions of the reproductive organs, which arouse in the brain a vague desire. Human beings, like animals, have no voluntary control over this bio-

chemical stimulus, but the more highly civilised the human being the more is he able to control the fulfilment of the desire. Now, human experience and experiments show that the subtile bio-chemical hormones produced by the reproductive glands of the respective sexes promote the development of those secondary sexual bodily and mental characters which in adolescence differentiate the male from the female. The primitive emotion of anger is in the male intimately associated with the sexual desire; it is excited by combat for the possession of the female, and in man this instinctive emotion shows itself in courage, which together with will-power is developed and is largely dependent upon the stimulus of insistent desire of the sexual instinct, which will cause him to brave all dangers, not so much, as in women, on account of parental instinct and love of offspring, as on account of the pleasure associated with the gratification of the desire. The pleasurable feelings associated with the gratification of the sexual appetite has been an all-important means of endowing man with courage, will-power, and sagacity, as well as physical strength; and it may be regarded as a device of Nature for the weeding out of poor types by survival of the strongest and fittest by natural selection and sexual selection.

There is considerable evidence in favour of a functional correlation of the ductless glands, viz. the thyroid, the suprarenal, and the pituitary, with the reproductive organs. The pituitary gland is a small body lying at the base of the

skull. One part of it produces a secretion which stimulates growth of tissues; and there is evidence to show that there is an intimate physiological association between this gland and the reproductive organs. It is possible that the periodic passage of an internal secretion of the sexual glands into the blood may serve as a hormone to this gland, causing it to pour into the cerebro-spinal fluid a secretion which acts as an excitant to the brain, and thus the sexual glands are indirectly brought into bio-chemical association with the brain. But whether the sexual desire is stimulated thus indirectly or by the direct effects of hormones produced by the sexual glands circulating in the blood of the brain, does not matter very much in the arguments respecting the organic needs necessary for the preservation of the species by the excitation of subtile bio-chemical substances stimulating the brain and creating an insistent desire, the gratification of which is associated with intense pleasurable feelings. All the higher as well as the baser sentiments have their roots in the desire for propagation, even more than preservation; for Nature is unmindful of the individual and mindful only of the species. Painting, sculpture, poetry, music, literature, and the drama owe their inspiration and fervour to the sexual passion; yet social traditions and customs conspire to throw a veil over the tree of life, the openly expressed knowledge of which has been regarded as the forbidden fruit. Modern social conditions tend to repress or suppress the natural

physiological gratification of the sexual passion, especially in women. When this happens, the *desire* is not suppressed, but causes a silent undercurrent of sexual passion, which, although it may not be manifest to the external world, nevertheless occupies a large place in the conscious and subconscious self; it suffuses silent thought and consciousness with an emotional tone which may find outward expression in æsthetic and religious observances or fanatical agitation; its suppression is one of the causes of insanity, especially in subjects with the neuropathic taint, for it tends to mental depression and the instalment of an anxiety neurosis, which in its turn leads to a disorder of the vital functions and a disturbance of the bio-chemical relations of the whole body, causing an auto-intoxication; thus a vicious circle may be established, by the interaction of a disordered mind and a disordered body.

From what has been previously said it is obvious that there is as radical a biological difference in the mind of woman and man as there is bodily difference, and this different mental attitude peculiar to sex shows itself in various ways. A woman is more timorous, impulsive, sentimental, and emotional than a man; she is intellectually different, for she has a natural quicker perception and association of ideas, and trusts rather to intuition than deliberation in forming a judgment. Consequently it may be inferred that she has a less stable mentality than man; it is not surprising, therefore, to find that functional nervous diseases and

disorders of the mind are much commoner in women than men, and that our asylums have more females resident than males. This also is due to physiological emergencies of the female sex connected with reproduction and childbirth.

Sex in Relation to Crime and Insanity

If an inborn tendency is the main cause of criminality, as some authorities like Lombroso and his followers assert, why should the proportion of female criminals be infinitely less than that of males?

Sir Bryan Donkin informs me that the total average population in local prisons for the year ended March 31, 1913, was 13,159 males and 2,375 females. Of course, the population is a shifting one: 143,718 males and 38,581 females were received during this period with sentences of very different length. Among the females a very considerable proportion are recurrent "drunks," and do not represent at all accurately the relative numbers of individuals convicted. To all who are interested in the question of crime and punishment I would recommend the reading of "Some Thoughts on the State Punishment of Crime" by Sir Bryan Donkin in a recent number of "Bedrock." In this article the author points out that "one of the most important results of the passing into law of the Mental Deficiency Bill will be the legal recognition of grades of responsibility that are now ignored, and a consequent diminution of

crime, as well as a better and more rational treatment of many irresponsible criminals." I have myself met with many cases of imbeciles and lunatics who have served several terms of imprisonment before it was discovered that a lunatic asylum was their proper destination.

Although the female characters of mind appear to predispose to insanity, either there must be some innate disposition of the sex which counterbalances those qualities tending to mental instability and lack of control, or it must be concluded that the major portion of crime is a social product. In my judgment both causes serve to explain the proportional disparity of crime in the female as compared with the male sex. Nevertheless, it is an undoubted fact that crimes of violence inspired in men by hatred and vengeance are frequently directly or indirectly caused by women; hence the truth of the saying, "Cherchez la femme."

Now, what are the acquired and innate qualities of the woman which tend to counterbalance the before-mentioned inborn characters of the woman's mind that predispose to nervous and mental disorders? The woman is animated by jealousy and hatred equal to and even surpassing that of the man, but physical inferiority combined with fear leads her more often to compass her end through the man whom she incites to vengeance. But the woman is more altruistic and less egoistic in feeling than the man; she is unconsciously far more self-sacrificing, and by virtue of the maternal instinct

more attached to home life and her children; she is more religious, and feels greater respect for public opinion, social customs, usages, and traditions; and by her attachment to home and family she is less exposed to temptations to drink, gambling, fighting, and immorality.

Human motives and conduct originate not only in the desires necessary for self-preservation, but also in great measure from the depths of the passion engendered by the natural attraction of the sexes necessary for the preservation of the species. The bodily characters that distinguish the sexes are different, so are the mental characters, for although each sex is represented in all the cells of the body, the sexual glands peculiar to each sex, by their internal secretions in process of ripening, make dominant the male or female secondary sexual bodily and mental characters. Observations and experiments show that the opposite sexual character is present in the somatic (body) cells, but it is latent or recessive.

Inheritance in Relation to Crime

No child is born insane, but it may be born with an insane or neuropathic tendency; certainly it may be born mentally defective owing to failure of development or arrest of growth of the grey matter of the brain. Such mental defectives are low-grade imbeciles and idiots, in whom there is a correlation of deficiency of mind and the material basis of mind the grey

matter of the brain. But the higher-grade imbecile, the epileptic, and the insane adolescent do not usually show obvious structural defects (even by the microscope) to account satisfactorily for the mental disorder; but this may well

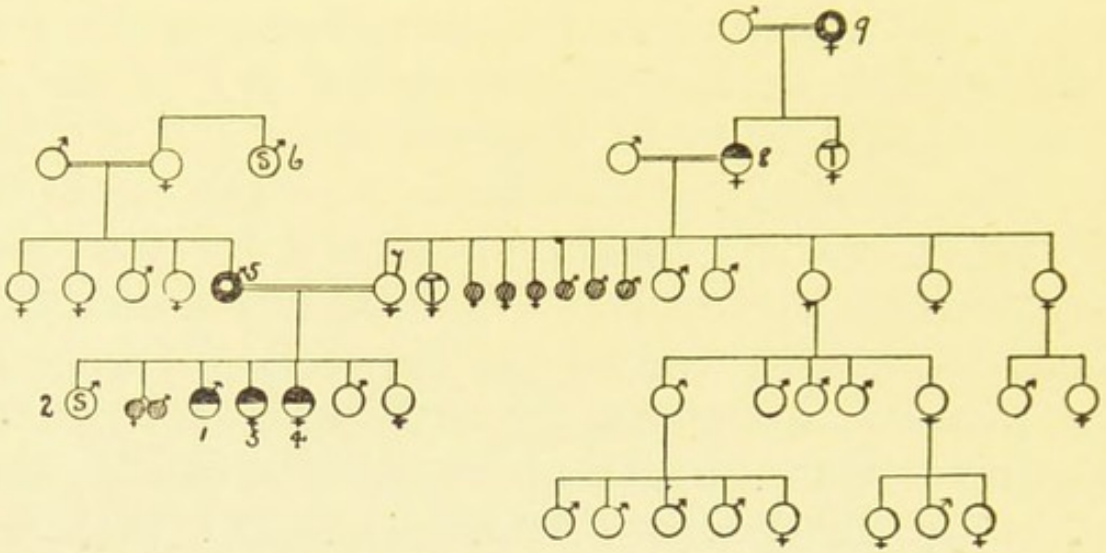


FIG. 17.—In the above pedigree the patient (1) was a murderer who was previously in the asylum for six months, suffering from adolescent insanity. His eldest brother (2) committed suicide by shooting. A sister (3) was in the asylum for adolescent insanity, and has again been admitted for melancholia. Another sister (4), a prostitute, is now in the asylum for the second time with melancholia, her first attack occurring in adolescence (adolescent insanity).

Paternal ancestry.—The father (5) is neurotic and very easily excited or depressed; his paternal uncle (6) committed suicide by shooting. *Maternal ancestry.*—The mother (7) is very dull and stupid, and prone to outbursts of violent temper; one of her sisters died from tuberculosis; six of her brothers and sisters died in infancy; the remainder and their progeny are apparently normal. Her mother (8) was confined in an asylum for a time suffering from puerperal insanity; a maternal aunt died from tuberculosis, and her maternal grandmother (9) "died from nerves." As the two sane individuals of this generation have not married, the chances are the degenerate stock has been ended.

be because methods have not been devised to exhibit the bio-chemical and bio-physical conditions underlying normal physiological processes in the organ of mind; and until we have some conception of this we cannot explain functional derangement of the organ of mind.

The raw material of character, good as well as bad, comes *through* the parents as well as *from* the parents, and it is a complex of innate potentialities dependent upon species, race, sex, and family ancestors. Just as we find some animals belonging to the same order are naturally docile, while others are vicious, and some more educable than others, so in the human subject there is a certain normal variability among individuals in the complexus of the primitive emotions and the instincts which are fundamental for the preservation of the individual and the species. But these primitive emotions and instincts are dependent upon fixed, stable, and pre-organised nervous and bio-chemical mechanisms, similar, though not the same, in all animals of the same order, including *homo sapiens*. Being fixed by evolution in the long procession of ages, they are least affected by environmental conditions and are the most permanent, so that when the later qualities upon which human character depends are either undeveloped, ill-developed, or stripped off by disease in later life, these animal propensities come out in all their nakedness. It is necessary to discriminate the inborn criminal from the criminal of necessity. The former is portrayed by Shakespeare in the "Tempest." Caliban is a mysterious creature, half fish, half monster—in fact, a man-animal, of whom Prospero, who has given him shelter, says: "A devil, a born devil, on whose nature nurture can never stick, on whom my pains, humanely taken, all, all lost, quite lost." Yet this born devil,

who has a great respect for Prospero's books, says:

> ". . . for without them
> He's but a sot, as I am, nor hath not
> The spirit to command,"

because he knows that in them, and the knowledge Prospero has gained by them, he possesses the power to subdue him. But Calibans are not common; and Lombroso's inborn types are limited to a small group of markedly degenerate criminals closely approaching the feeble-minded.

Racial Inheritance and Crime

Grafted on to the stock of fundamental biological characters of the species are the characters of body and mind peculiar to race, to sex, and to ancestors. Just as there are structural characters of the body (including the brain—*e.g.* short heads and long heads) peculiar to different races, so there are temperamental characteristics. These inborn racial temperamental qualities play an important part in the complex formation of the raw material of character, and therefore in the relation of inheritance to crime and insanity.

Although human conduct is, broadly speaking, dependent upon similar motives and desires in all races, yet the desires are more impelling in some races than others, and control is consequently less, so that the emotions are more readily inflamed and the passions roused. For this reason, among the Latin races the penal

code recognises the justice of mitigation of punishment in "les crimes passionnels."

Temperament and the expression of our emotions and feelings are largely dependent upon racial inheritance, and the characteristic mental activities peculiar to each sex are indicative of the intimate mutual interdependence of body and mind. A good raw material inheritance requisite for survival in the struggle for existence postulates an adequate combination of mental energy and mental sagacity. Nurture can exercise a marked influence on the development of mental energy by ensuring bodily health and strength during development, and by education and upbringing in a healthy mental environment, it can develop, without wasting mental energy, the inborn potentialities essential for efficiency in the struggle for existence. Nurture, however favourable, cannot give mental sagacity if it is not inborn, nor can it do more than bring out the good qualities that the raw material of inheritance has provided; but it must be remembered that nurture plays an all-important part in the preservation or the spoiling of good raw material in all classes and grades of society. However paradoxical it may seem, nevertheless it is true that the inborn virtue of an unselfish, confiding, amiable, and optimistic nature may be the cause of an acquired vicious character under the influence of evil suggestion and imitation; whereas a calculating, suspicious, and selfish nature under similar circumstances would escape contamination.

> Virtue itself turns vice, being misapplied,
> And vice sometime's by action dignified.
> —*Romeo and Juliet.*

We can, then, understand *why* the feeble-minded and epileptics, who have only a narrow margin of highest control, readily yield to the impulses of passions and animal instincts, or are unable to resist temptation when opportunity offers. In respect to crime, however, there are a large number of sane people who have the desire to win wrongly, yet not to play false; but when there is a big advantage they are tempted to do so, especially if there is a good chance of not being found out. These constitute the great flock of criminals of opportunity in all grades of society, but found out and punished often in inverse proportion to their deserts.

The foundations of moral and intellectual characters are inborn, but the influence of education, example, and environment generally is much more potent for good or evil than in the case of physical characters. I cannot do better than conclude this account of the "Raw Material of Character" than by recalling the words of Sir Thomas Browne: "Bless not thyself that thou wert born in Athens, but among thy multiplied acknowledgements lift up one hand to heaven that thou wert born of honest parents, that modesty, veracity, and humility lay in the same egg and came into the world with thee."

THE INFLUENCE OF NUTRITION AND THE INFLUENCE OF EDUCATION IN MENTAL DEVELOPMENT

I HAVE already pointed out that the brain consists of innumerable nervous units or neurones, and that these nervous units or neurones are collected into groups, systems, and communities having different functions, but that broadly speaking they form three great groups or classes —viz. (1) afferent sensory chains of neurones; (2) efferent motor chains; and (3) association chains of neurones (fig. 1). A neurone consists of a nerve cell and all its branches; one branch forms a nerve fibre which is called the axon, because it forms the central axial core of the nerve, the other branches, like those of a tree, are called dendrons. The grey matter of the cortex covering the surface of the brain which is the seat of consciousness consists of countless millions of nerve cells and processes and thus gives it its grey appearance.

INNATE POTENTIALITY OF THE NEURONES, AND BRAIN DEVELOPMENT

In the child's brain before birth these cells are packed closely together, and at one period they

have no processes; as the brain develops and grows these cells, which are termed neuroblasts (neurone-formers), send out processes which, extending and branching like a tree, lead to an increased complexity of structure. This capacity to grow and develop is inherent in all the neuroblasts of the brain, but in order to grow and develop they must be fed by the blood with suitable food. Just as some individuals with abundance of food supply do not develop and grow because they are unable to take it, or if they do, to assimilate it; so with the neurones, if there is an inborn failure to take up from the blood and assimilate the food supplied, they will not develop and grow.

The neurone is a complex cell behaving like a living organism; it nourishes itself and is not nourished. Now the neurones forming the grey matter of the cortex are the most complex and latest developed ontogenetically and phylogenetically, consequently the germinal determinants of these cells are less fixed and stable, therefore more likely to undergo pathological mutations than other cells of the body under the influence of chronic poisoned conditions of the blood of the parents. Whether this be so or not, it is certain that these cells are the latest to mature and become capable of active employment, thus they are more susceptible to arrest of growth, and development by prenatal and postnatal nutritional failure, or by poisoned conditions of the blood. Various forms of failure of development of the brain occur owing to the

lack of innate capacity or specific energy of the neurones to grow, and since the brain does not grow the skull-bones also fail to grow, and we have what is termed a microcephalic idiot. It was at one time thought that the brain was prevented from growing by the closure of the bones of the skull, and surgeons attempted to remedy this by removing pieces of the skull so as to allow the brain space to grow; but experience proved that the operation did not cause the brain to grow and the operative treatment of microcephalic idiocy was given up. A little reflection and observation would have shown that the brain is the master tissue and determines the growth of the skull, and the reason why the skull closed early was the natural response to the cessation of the dynamic force of growth of the nervous structures of the brain. I have already alluded to the fact that all the tissues of the body will suffer in order that the brain may grow; in starvation the brain hardly loses any weight. The brain weight of infants dying of exhausting diseases does not seem to suffer, and the experiments of Donaldson at the Wistar Institute (already alluded to) show that imperfect nutrition does not lead to arrest of growth and development of the brain. An inborn germinal lack of capacity of the neurones forming the anatomical basis of mind to develop and function properly cannot be remedied by improved nutrition of the body, and this is shown by the fact that mental deficiency is found in children of all grades of society; in fact, the majority of

cases of feeble-minded children are ineducable because of an inborn physiological deficiency.

The Blood Supply and its Quality, in Relation to Growth and Function of the Brain

Have nutrition and education, then, no influence in mental development? Let us first consider the subject of nutrition from a physiological standpoint. The brain in order to grow and function requires a proper supply of oxygenated blood containing the necessary materials out of which the nervous matter can be assimilated and built up. We know that if the secretion of the thyroid gland is lacking owing to congenital absence of the gland, the brain is arrested in its development, and the child is a cretinous idiot. Medical science has shown that if the cretinous child receives daily a small quantity of thyroid gland (obtained from sheep), it stimulates the brain cells to grow and probably supplies the blood not only with an excitant to growth but some essential substance for the growth of the brain tissue. The reason why there is such a large blood supply to the grey matter of the brain is that important biochemical processes occur there, constituting the physiological basis of mental activity. In all mental operations nervous energy is used up; the neurones are the agents for the storage and liberation of nervous energy; and its liberation is the physiological basis of mental activity,

whether it be in simple or complex processes. The neurones automatically store energy when they liberate it, but there is a reserve store for emergencies. Now liberation of nervous energy, that is, conversion of latent neuro-potential into active neuro-potential involves oxidation; consequently oxygen is essential for the process. This is shown by the fact that unconsciousness results if the cortex of the brain is deprived of arterial blood for a few seconds.

We are conscious of the external world and our own personality and existence by continuous stimuli arising from the external world and from our own body. If those stimuli were cut off, we should lose consciousness, notwithstanding that the blood supply to the cortex of the brain continues. The neurones of the cortex of the brain, besides innate potentiality to function, require also the stimulus from the external world together with a proper supply of oxygenated blood; and this implies a sufficient number of red blood corpuscles provided with an adequate quantity of the red colouring matter—hæmoglobin. Not only may an impoverished blood deficient in red blood corpuscles and other essential constituents be the cause of a mental functional deficiency by depriving the nervous elements of their capacity to grow, develop, store, and liberate energy, but a poisoned condition of the blood is a far more frequent cause of acquired failure of mental energy in infants and children as well as in adults. Such impoverished and poisoned conditions of the blood

in infancy arise in a large majority of cases from gastro-intestinal disturbances owing to improper feeding, and may, if continuous, interfere with bodily nutrition and brain development. The intelligent mother accepts such warnings as fits of screaming, restless sleep, crying without obvious cause, refusal of food, and convulsions; she does not think the infant exhibits these symptoms from temper, but as an evidence of suffering requiring maternal sympathy and protection, and she seeks the cause in order to remove it. Now, imperfect nutrition and poisoned conditions of the blood brought about by fermentation and putrefaction in the gastro-intestinal canal from improper feeding, and from acquired or inherited disease, may not actually arrest the growth of the neurones of the brain any more than they may materially interfere with the growth of the child, and cause arrest of development; but such unfavourable conditions of nutrition at the time when the brain is undergoing its most active development cannot but be harmful. I have previously said that during the first three years after birth the greatest increase in the weight of the brain occurred, and that at three years old it had trebled its weight at birth. Even if with an unfavourable bodily nutrition of the infant the brain grows and develops to nearly treble its weight at the end of three years, we cannot therefore assume that it has in no way suffered from mal-nutrition, any more than we can assume that because a child has grown in stature a few inches less

than a well-nourished child, it has not seriously suffered. You naturally ask: How, then, has the brain suffered? It has suffered constitutionally, as the child has suffered constitutionally; it is less able to resist the effects of stress from any cause; it is more liable to exhibit signs of nervous irritability, convulsions of teething, and if the child be infected by the micro-organisms of pneumonia, tubercle, whooping-cough, measles, or scarlet fever, the brain, as well as other parts of the body, has less vital resistance to the poisons produced by the organisms.

The Health of the Mother in Relation to the Child

The health of the mother plays an important part in the health of the child from the time conception takes place even till the child grows up and leaves its home. For a long time efforts have been mainly directed to the reduction of infantile mortality, and the success attending them has, as Dr. Amand Routh in a Lecture on Ante-Natal Hygiene pointed out, been sufficiently obvious by the reduction of the death-rate among infants under one year of age in 1912 to 9·5 per 1,000 births. But he states that practically as many infants die during fœtal life as during the first year of their independent existence, and he urges the necessity of adopting measures to prevent this colossal waste of pregnancies and human life. During the period of gestation till birth all causes which injure the

vital processes of the mother must affect the growing embryo, and of these, poisoned conditions of the blood are the most important. Some poisoned conditions of the blood are so serious as to cause premature death of the embryo, resulting in miscarriages and abortions; the most important of these is syphilis, because it is a living organism, which, entering the tissues of the growing embryo and multiplying there, causes its death. Chronic lead-poisoning occurring in certain occupations—*e.g.* in the potteries where lead is used for glazing—causes miscarriages and abortions from death of the embryo. The knowledge that lead-poisoning causes abortion has led to the employment of pills made of lead plaster by poor women to procure abortion, and if lead does not effect this purpose it must materially devitalise the infant when born. Syphilis is a widespread cause in our large cities of the waste of pregnancies, and unfortunately a slaughter of the innocents follows the miscarriages and still-births; for children are then born to the infected mother who, *unless treated*, may live only a few days or a few years, as they very frequently die in infancy of convulsions, meningitis, or hydrocephalus (water on the brain); and perhaps this is better than if they lived, for they may subsequently become blind, deaf, or mentally defective. The pity of it is that this waste of life and suffering could be prevented by modern methods of diagnosis and treatment. A mother who has been infected may eventually, after a series of miscarriages, dead and diseased children,

have an apparently healthy child. This child may not be really free from the infection, only the virus has become attenuated, for the mother has eventually given to the offspring a certain degree of immunity. The blood test would show that the specific organism was in the body of the child, although apparently healthy. We cannot, however, believe that this apparently healthy child possesses the same vitality as if it had been born of healthy, non-infected parents; indeed, evidence is accumulating to show that such children may exhibit later epilepsy or mental enfeeblement.

Another venereal disease which is especially dangerous to the infant is gonorrhœa; this infective disease is the great cause of ophthalmia of the new-born child and a widespread cause of blindness. Moreover, it is dangerous to the mother's health and the most frequent cause of sterility. The conspiracy of silence which has prevailed in the past concerning these diseases has at length broken down; and it is hoped that the Report of the Venereal Commission will do much to educate the public conscience and awaken the Government to the necessity of protecting innocent women and the unborn millions from these scourges of humanity, causing untold suffering and misery.

Another devitalising cause is alcoholic poisoning of the parents, the influence of which upon the offspring it is always difficult to estimate, as the data employed for statistics are not always comparable or reliable. Many cases of chronic

alcoholism in the parents are complicated by syphilis, which, being due to a living organism growing and multiplying in the body of the developing embryo, is really the cause of the miscarriages, premature births, and deaths in infancy. Alcohol and syphilis work together in their destructive effects. The former is a poison which depends upon the quantity taken; the latter is due to a specific infective organism which has unlimited powers of multiplication in the body. Chronic alcoholism, by lowering the vital resistance of the blood and tissues, favours enormously the growth of this organism as it does of other organisms which cause disease. Moreover, alcoholism is one of the most potent agents in the spread of venereal disease. It is safe to assume, however, that (apart from syphilitic infection) chronic alcoholism causing a poisoned condition of the mother's blood will seriously affect the nutrition and growth of the embryo, though not to the degree that many total abstainers believe; for sufficient allowance, in the high rate of the infantile mortality of non-syphilitic alcoholic mothers, is not made for the fact that a drunken mother is careless about the feeding of her offspring, and we know that gastro-intestinal complaints from improper feeding are by far the most fruitful cause of infant mortality. Experience teaches that if these infants, born of alcoholic parents, are taken away from their mother and brought up they not only survive but flourish. Nevertheless, it is hardly conceivable that the germ

cells are uninfluenced by a continuous saturation of the blood by poisons; and in connection therewith it must be remembered that it is not only the alcohol which produces the poisonous effects, but that, by the continuous action of the alcohol on the stomach, intestines, and liver, which causes their vital functions to become permanently deranged, microbial and other poisons engendered within the body of the mother are able to be absorbed with the blood from the intestines, and such poisons not being destroyed or rendered inert as the blood passes through the portal circulation of the liver, they enter the blood stream of the general systemic circulation.

The germ cells are marvellously protected against the effects of poisons, but there is no physiological reason why the germ cells should not suffer eventually in their specific energy if they are supplied for a long period of time with a vitiated blood supply, especially when this is continued in successive generations.

Tuberculosis of the Parents

Undoubtedly children born of tuberculous parents are more susceptible to tubercular infection; there is no reason, however, for supposing that infection of the developing embryo takes place, as is the case with syphilis. Tuberculosis in the mother does not as a rule lead to miscarriages and still-births; the infant is healthy at birth, but it inherits a suitable soil for the development of the tubercle bacilli, and if the

mother or father be suffering from active tuberculosis the chances of infection of the offspring are great ; moreover, if it has been fed on tuberculous cow's milk that has not been sterilised, infection takes place much more readily than in the case of an infant born of non-tuberculous parents. It might be urged that this is Nature's method of elimination of poor types, but it must be remembered that the child is born free from infection, and it is the duty of the State to protect the infant. In this respect health visitors are of great service, for they can instruct the parents in methods of prevention of infection, and especially the mother, who can thus be advised concerning the feeding.

Infant Feeding

The child is born into the world with an instinctive desire for the mother's breast ; the act of sucking the breast is performed by an instinctive complex preorganised nervous and muscular mechanism, and interference with that instinct by artificial feeding is unnatural to the infant and the mother ; *a priori* on physiological grounds, therefore, neither good for the one nor the other. Yet how many mothers wantonly sacrifice Nature's provision for the nutrition of their offspring from selfish motives. Others, again—and they are more numerous in modern highly civilised communities—are not supplied with a sufficient abundance of nutritive energy to provide enough milk to satisfy the child, and

artificial feeding has to be resorted to. Without artificial feeding large numbers of poor weakly and anæmic mothers would not be able to rear their offspring, and eugenists might assert with justice that artificial feeding has permitted every weed to propagate and rear its kind. Whether artificial feeding is resorted to from necessity or not, it cannot be too plainly or emphatically stated that there is no perfectly satisfactory substitute for Nature's provision either in the quality of the milk or in the mode of its supply by the mother's breast.

In France the system of feeding the mothers and so improving their nutrition to enable them to have a sufficient supply of good milk to nourish their offspring is a plan that commends itself to me, provided we can be sure that the mother gets the food and it is a proper food for improving her nutrition.

This system of feeding up poor mothers should be begun during pregnancy, for during its course very definite changes are taking place in the maternal blood, causing all the organs and tissues of the body to be activated by a greater vitality.

Children often suffer from over-feeding and from being given unsuitable food that sets up gastro-intestinal irritation, vomiting, and diarrhœa with various manifestations of nervous irritability due to absorption of bacterial poisons by the blood. It is certain that the greatest preventable cause of infant mortality and constitutional weakness of the child after birth is improper and

insufficient feeding. Ignorance is the cause, for mothers often give the infants the same food as they have themselves, and the feeding-bottles, tubes, and teats are not kept clean, and the milk is infected by organisms, so that it is never wholesome. Health visitors can teach the mothers how to prepare the infant's food; however, collective responsibility should not be undertaken to replace parental responsibility, only to educate and assist it; and this is the method adopted by health visitors. This system of educating the mothers is beginning in a right way by giving every infant a better chance for growth of body and mind. Collectivism and individualism should work together by improving the mother's health and instructing her how to nourish her offspring. I have already pointed out that the natural food for the infant up to the time that it has teeth is the mother's milk, which is the only perfect food for the baby during the first nine months of its life, and only under exceptional circumstances is it justifiable to employ artificial feeding, in the interests not only of the infant but of the mother also. For not only has nature provided the milk glands, but also an internal secretion by the cells which occupy the position in the ovary whence the ovum that developed into the child came, and this internal secretion has the special function of stimulating the secretion of milk. Prof. Karl Pearson in his second Chadwick Lecture showed the fallacy of statistics in regard to infant mortality and various modes of feeding in town

populations. His argument was that the statistics showed that infant mortality only corresponded with the health and habits of the parents ; it did not seem to matter whether the child was breast fed or artificially fed, nor did it seem to point to one form of artificial feeding being superior to another. Are we therefore to conclude that it does not really matter whether a child receives the nourishment nature itself provides or not ? No ! The reason why artificial feeding of infants appeared in statistics to be as good, or better than breast-feeding, is that poor and destitute mothers unable to purchase milk are very numerous. They themselves have large families which, owing to their own nutritional failure, they are not able to rear, owing to the poverty of their milk.

Another important matter in respect to the mother's health is the question of occupation other than that necessary to maintain the home. We must first declaim against the opinion that a woman is doing the best for the unborn child by laying up and doing nothing. Daily exercise in the open air and occupation for mind and body, whereby normal physiological functions are carried on and nutrition maintained, are essential for the health of body and mind of the mother. The household duties in the maintenance of the home of the large mass of married women of the working classes should not interfere with the normal bodily nutrition, unless the woman is much overworked by duties occasioned by the bringing up of a large and young family. In the case of artisans earning a fair wage it

is unnecessary and therefore undesirable for the mother to engage in daily occupation outside her home; but a large section of the poorest population in our large cities is made up of families where the father depends upon precarious casual labour and the mother helps to maintain the family by daily occupation; yet I am sure that it is better for the unborn infant that she should do this, than suffer from malnutrition owing to extreme poverty and destitution. Yet as an editorial in the "British Medical Journal," February 19, 1914, on Dr. Routh's lecture points out, it is unprofitable to the State and unfair to the woman and her family to inflict upon a prospective mother not only the duty of nourishing her unborn child, but also a daily struggle as a bread-winner; and the writer advocates guarding the child from all preventable accidents when conception has taken place. Dr. Routh rightly suggests the establishment of a pre-maternity benefit in connection with the Insurance Act.

Dr. Addison[1] has recently said "the State confronts the medical profession with 600,000 ill-nourished children in our elementary schools, with 300,000 who have adenoids; it deplores the waste of infant life; it discovers there is an army of factory girls and women workers with anæmia and chronic indigestion." What they need much more than drugs prescribed by panel doctors is good food, fresh air, and clean, well-ventilated homes. This will not be attained until those who are responsible for making reports "upon

[1] "Medical World," February 12, 1914.

the conditions and home life of the people are free to tell the truth, the whole truth, without fear or favour," and without incurring thereby an insecurity of tenure of office. I have added an Appendix, giving the practical experience of Medical Inspection of School Children by a Lady Sanitary Inspector and Health Visitor.

Stimulus in Relation to Development of the Brain

There are two other factors to consider beside innate potentiality of the neurones and their supply of the necessary materials for growth by a pure and adequate blood supply. They are the stimulus to growth by the physical and chemical excitation of the nerve endings in the sense organs and bodily structures. Let us consider this a little more fully. The infant learns to know its own existence and the desires necessary for its life by its organic sensibility ; the nerve endings in the skin, muscle, tendons, and joints carry messages continually to the brain, inciting the desire to breathe, to take nourishment, and to perform the calls of nature. The special sense organs associated with the muscle sense—which contributes to every other sense—are especially represented in the grey matter covering the brain ; they are the avenues of intelligence and by motor reaction and adaptation the source of information concerning the external world. As I previously pointed out,

preparedness for function by myelination is first shown in the structures of the cortex which serve as the arrival platform of sensations of organic and bodily sensibility, of smell and of taste ; then of vision, and lastly of hearing ; these, combined with the kinæsthetic sense, constitute the primary perceptive centres. A simple experiment shows that the chains of neurones which constitute the peripheral receptor (sense organ), the transmitter, and the central perceptor have the power of transforming cosmic energy into neural energy. The experiment is this : if you take a pair of fine electrodes connected with an electrical apparatus discharging an interrupted electrical current, and place them on the tongue, a sensation of taste is produced ; if on the skin a vibratile sensation is felt ; if the eyeball is excited a bright light is seen ; and if the nerve of hearing is stimulated a noise is heard. Since the stimulus does not vary in any one of these experiments, it necessarily follows that each sensory nervous mechanism has the power of transforming the stimulus and producing a specific effect on consciousness. The neurones then not only act as receptors, but transformers of energy, and they use up oxygen in the vital functions associated with this specific transformation. Moreover, traces of the specific effects are left in the perceptor cortical neurones constituting memory. Now what will be the effect on the growth of the neurones forming the central perceptor for vision, if the child is born blind, and all light stimulus is thereby cut off from the brain ?

PLATE VI

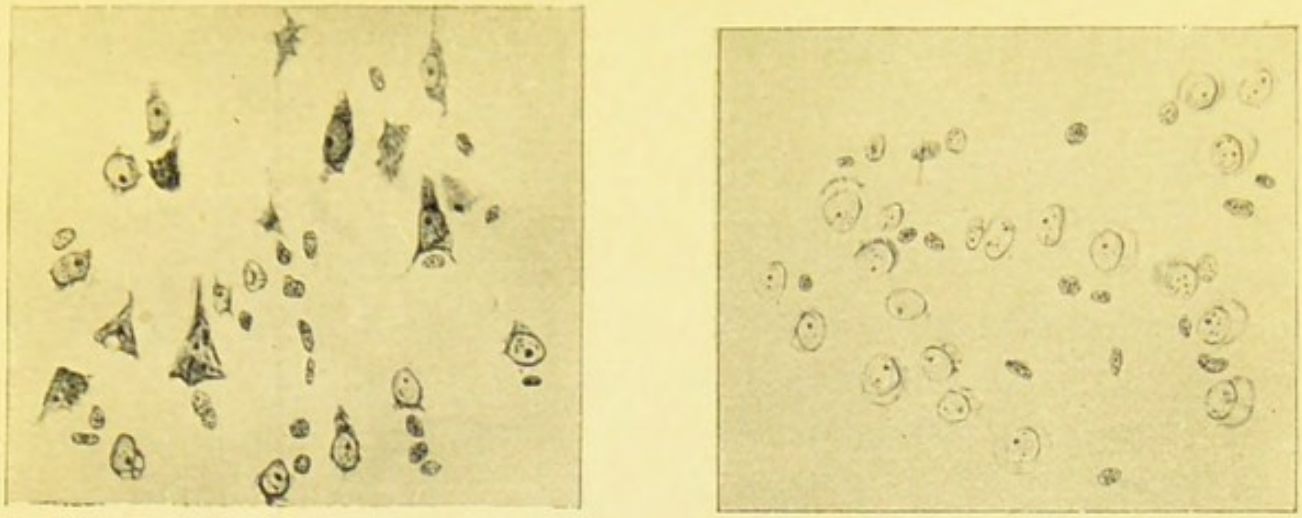


FIG. 1.—Two groups of cells, one from the occipital cortex of a normal dog, the other, pale undeveloped cells, from the dog with the eyes removed at birth. (After Berger.)

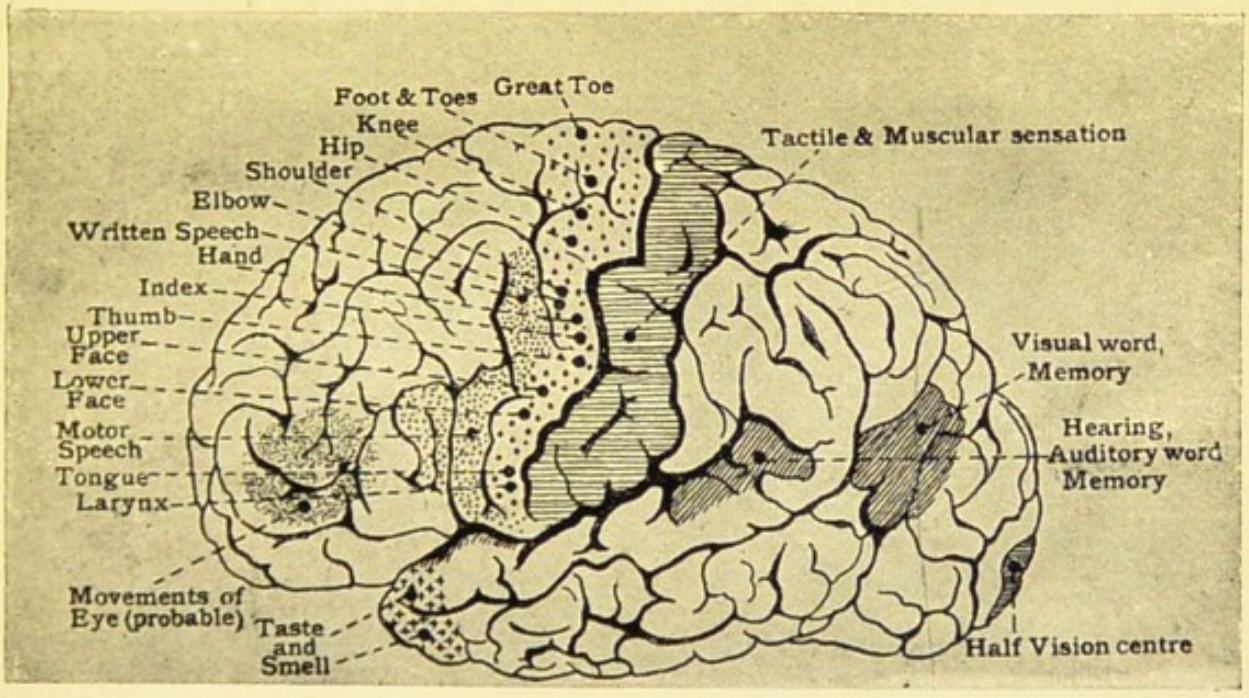


FIG. 2.—A lateral view of the left hemisphere, showing the localisation of the various motor and sensory spheres and speech centres.

The greater part of the visual centre is on the mesial surface of the hemisphere and is not shown; likewise the greater part of the auditory centre lies in the floor of the Sylvian fissure, and is covered up and concealed.

It is claimed by Berger that experiment has answered this question. A microscopic examination of the visual area of the brain of a puppy whose eyes were removed at birth was compared with a normal puppy, and the figures (Plate VI, fig. 1) show that the cells of the grey matter of the blind dog were small and shrunken as compared with the cells of the grey matter of the normal dog. Stimulus, therefore, is necessary for development and growth of the neurone.

But this experiment proving that the visual cortex of the brain fails to develop properly is not accepted by many eminent authorities. Von Monakow has not found any perceptible changes in the visual area of the cortex cerebri of human beings who were blind from birth. That the visual area of the cortex does play a very important part in orientation in space in blind animals is shown by the fact that a dog made blind by the removal of the eyes at birth soon finds its way about the laboratory perfectly well ; whereas an animal made blind by destruction of the visual (perceptor) area of the cortex cerebri would grow up a stupid animal unable to orientate in space and find its way about—in fact, such an animal is comparatively uneducable in this respect. These experiments on animals are of very considerable interest in relation to some remarkable cases of deprivation of special senses in human beings either at birth or in early infancy.

The Remarkable Cases of Laura Bridgeman, Helen Keller, and Marie Heurtin

These three cases are not in all respects parallel, but Helen Keller and Laura Bridgeman may certainly be considered together. Both Laura Bridgeman and Helen Keller were not affected with blindness and deafness till such a time after birth had elapsed for a very complete development of the association systems (*vide* Plate V). Sensory stimuli had, during early life, poured into the brain through all the sensory avenues for twenty-six months in the case of Laura Bridgeman and for nineteen months in the case of Helen Keller ; consequently, we should not expect those regions of the brain which had served for seeing and hearing—and which had been shut off by damage to the transmitter only—to undergo atrophy and arrest of development and function from lack of stimulus the same as in the case of Marie Heurtin, a congenital deaf-mute who was born blind, the only sources of intelligence being the tactile-motor sense and that of smell. Now the kinæsthetic sense is a sense which contributes to every other sense ; for every sensory perception tends to expression and action, and every motor action is always associated with corresponding incoming sensory stimuli by which the mind becomes aware of the range and direction of the movement (*vide* Plate I), and the bodily change effected by it. This kinæsthetic sense then becomes inseparable

from other sensory perceptions occasioned by stimuli from the external world; it is especially associated with touch and vision, also hearing in the judgment of direction whence sounds come; but especially is hearing associated with the sense of movements of the lips and tongue in the production of articulate speech and song (*vide* Plate II, fig. 2). It is generally admitted that in an uneducable low-grade idiot there is a defective development of the cerebral cortex. "Eyes have they and they see not, ears have they and they hear not"; that is, with understanding. They are indeed mind deaf and mind blind, because the "anatomical basis" of mind is congenitally defective.

All these three remarkable blind and deaf individuals were in the highest degree educable, and they were educable because the "anatomical basis of mind," the cerebral cortex, had not been destroyed or arrested in development, and in all three there was left open the path of the tactile-motor sense by which all the innate potentialities of the brain could be developed. The innate potentialities of the brains of Laura Bridgeman and Helen Keller must have been of the best, and the greatest credit is due to that great pioneer Dr. Gridley Howe for finding his way to Laura Bridgeman's intelligence through her finger-tips. His plan was to teach her by raised type and then by the manual alphabet.

One of the most interesting psychological studies that I know is "The Story of My Life," by Helen Keller. She was evidently a

precocious child, for at six months she could utter articulate sounds; even three months after the illness which made her blind and deaf she uttered the word "water." She walked at one year, and as she says, "During the first nineteen months of my life I had caught glimpses of broad green fields which the darkness that followed could not utterly blot out." In the first months after her illness she says: "My hands felt every object and observed every motion, and in this way I learned to know many things," and she indicated her wants by gesture language encouraged by her mother. She lived a normal life on a farm *sans* sight and hearing, but was wonderfully intelligent and exercised reason in her actions. She was always happy when she could keep her mind and fingers busy. Systematic teaching by Ann Mansfield Sullivan was commenced when she was seven, the system being the association of tactile-motor verbal symbols made with the finger in the palm of the hand with the tactile-motor impression of objects. Everything had a name and each name gave birth to a new thought. She remarks: "At the first I was only a little mass of possibilities; it was my teacher who unfolded and developed them." At the age of ten she learned to speak. She was taught by a Miss Fuller, and the method, in Helen Keller's own words, was this: "She passed my hand lightly over her face and let me feel the position of the tongue and lips when she made a sound." In reading her teacher's

speech she was dependent on her fingers, she placed her hand on her teacher's throat, mouth, and face, and read the vibrations and movements of the mouth and expressions of the face; the same movements she learned to reproduce and thus learned to acquire articulate speech, but not hearing the sounds she was unable to modulate the voice. The sense of movement combined with touch and smell were in her case the sole avenues of stimulus to the brain from the external world, but inasmuch as all the primary sensory areas including hearing and vision are connected with these areas by association channels, the whole brain responded to the stimulus and developed to the full its innate educable possibilities.

The process of organic and of mental evolution has been continuous, and on the grounds of analogy it is improbable that the process of evolution so uniform throughout Nature does not apply to the human brain—the organ of mind.

It may be assumed that "Man's place in Nature" has been slowly acquired by evolution, and that one of the capital factors was the acquirement of articulate speech and abstract thought, the employment of which in successive generations has so far become organised in the brain, by transmission for untold ages, as to induce an innate potentiality of the left hemisphere in the majority of people, causing a prepotency for that half of the brain in initiatory volition as applied to articulate speech and the right hand as the instrument of the mind. I

need not remind the reader that the left half of the brain controls the voluntary actions of the right half of the body; that this is so is proved by the fact that injury or disease of the left hemisphere is followed in many cases by loss of articulate speech (aphasia) and paralysis of the right half of the body (hemiplegia). In born left-handed persons the right hemisphere is prepotent, and damage to it may cause aphasia and left-sided hemiplegia. In support of this proposition I may mention that an extensive inquiry by Dr. Ballard in schools where ambidexterity was taught indicated that it caused stuttering and stammering in a large percentage of the children who were born with right-handed or left-handed prepotency. But although the left half of the brain in the majority of people is prepotent, this does not signify that the whole brain is not engaged in all mental processes of thought and expression. This human innate potentiality is an organised educability of the cortex cerebri to think, reason, and speak verbally or by graphic signs; but it is only a latent potentiality, for without knowledge of the tactile-motor, auditory, or visual signs and symbols used to form words necessary for language abstract thought is impossible.

Now in the case of all three girls the tactile-motor avenue was the only path open through which the "social heritage of mankind" could be conveyed. Physiologists would have much less difficulty in explaining the extraordinary mental development of Laura Bridgeman and

Helen Keller, for they could point to the fact that they had received light and sound stimuli for some time after birth; from which it might be concluded that the neurones of the sensory cerebral perceptors and the association neurones which unite them, thereby enabling the formation of concepts, had received the necessary specific stimuli by all the sensory channels required to arouse all the inborn human latent faculties of the mind derived from ancestors which even when the sensory avenues were closed were, as Helen Keller says, never completely obliterated from the memory. This may account for the difference between the dreams of Helen Keller and those of Marie Heurtin.

Now the deaf, dumb, and blind child Marie Heurtin, we are told, not only had the great disadvantage of never having seen or heard anything for one moment since her birth, but she (unlike Helen Keller) "had lived in an absolutely savage state up to the age of ten years." She was the child of first cousins; her father was a cooper at Vertou, and both parents were poor and illiterate, but honest. No doubt there was a latent taint of deaf-mutism in the family, and this became dominant by consanguinity; for of the children three were congenital deaf-mutes, two of whom were blind, two were healthy, one died in infancy, and one in early life of rickets. The two sisters Marie and Martha were blind deaf-mutes. Marie, the elder, was taken to a convent and educated by the Braille system by Sister Sainte Marguerite.

M. Harry states that Marie acquired "some knowledge of geography and arithmetic, a small amount of history, a general idea of the chief elements of organisation of the physical world, and, above all, the knowledge of all that a careful religious education implies." Unlike Helen Keller, who during sleep is in possession of the normal faculties of seeing, hearing, and acting in her dreams, Marie Heurtin is said to see nothing and to hear nothing; her dreams are related only to the tactile-motor sensations received from the instructress's finger in the palm of her hand, which were the sole source of her thoughts. Thus Marie said she often dreamed, and related one of her dreams to M. Gerard Harry, from a translation of whose book, "Man's Miracle," I have obtained the information concerning her education and life. In this dream she said she thought she was walking towards Poictiers, which she often did with some companions and Sister Sainte Marguerite. At the turn of the road was a church. They went in, but the church was full of armed soldiers, who were evidently filled with the worst intentions. Marie was much frightened and woke with a start. She was asked: Did she see the troop of soldiers, their uniforms, their bayonets, their faces? "No," she answered. "Sister Sainte Marguerite, speaking to my hand, told me they were there, after telling me in the same way that we were going into the house of God. I never see with my eyes when I dream." She wrote this down and signed it "Marie Heurtin."

There is no doubt that this dream originated in her having been told of the threatened expulsion of the sisters by soldiers. That dreams are revivals of memories of previous experiences dependent upon sensory impressions is clearly shown by these facts.

This case of Marie Heurtin, born without powers of sight or hearing, and who, if she possesses less intellectual capability than Helen Keller, has nevertheless been educated, for she can read, write, play such games as dominoes, and discover a realisation of objects and their places in the world's economy that is hardly less accurate than the realisation possessed by the average common woman born with all her sensory avenues unimpaired,—these facts prove, to my judgment, that the innate potentiality of the brain is the dominant factor in educability; and show, moreover, how careful we must be in deciding whether a child is ineducable. It cannot be denied that the family history and the condition at ten years of age of this blind deaf-mute offered but a poor prospect of educability, yet patient endeavour was rewarded by remarkable success.

A thorough comparative study by a trained psychologist of Helen Keller and Marie Heurtin would be worth any amount of laboratory research in unravelling some of the problems of psychology. In all three of these girls there was the desire to be educated; attention was obtained because of the intelligent interest and devoted self-sacrifice of the teachers. The

photographs of Helen Keller and Marie Heurtin bespeak intelligence, and expression is often a useful guide in determining educability, though by no means can it always be relied upon.

Sleep and Mental Development

We now come to the last factor requisite for proper development of the brain and especially its efficient function—sleep—that sweet unconscious quiet of the mind which permits all the vital bodily functions to continue (although less actively) while the cortex of the brain rests and the whole organ stores energy and recuperates.

We must look upon sleepiness occurring not because there is an actual exhaustion of the brain, but in order that it may not be reduced to that extremity. Every normal child, like the adult, but in less degree, possesses a store of nervous and muscular energy over and above that which it requires in ordinary conditions of life; and this statement is borne out by all the known facts, experimental and otherwise, concerning mental and bodily fatigue. The reserve energy certainly varies in amount in different individuals; it is intended only for emergencies, and should not be habitually drawn upon. The sense of fatigue and the desire for sleep may be regarded as the protective and the instinctive guardians of this reserve of nervous energy. Both give warning that the reserve is about to be drawn upon; and if the warning is continually allowed to pass unheeded, exhaustion of the

highest inhibitory function of the brain cortex ensues, and associative memory, thus left unchecked, permits a continuous flow of ideas, resulting in mental excitement and sleeplessness. A vicious circle tends thus to become installed which, if not broken, leads to bankruptcy of nervous potential, with permanent mental irritability and lack of mental energy. A neurasthenic condition, with insomnia, is very prevalent now in highly civilised communities among young adults owing to overpressure at school and college in competitive examinations, and quite young children of a nervous temperament, owing to parental indiscretion in their upbringing, may suffer from it. Sleeplessness of the child is a sign of nervous irritability and exhaustion, and requires careful attention lest worse evils follow.

Darkness, stillness of the body, and silence favour sleep by removing the principal causes of wakefulness and activity of the mind. Habit fortunately permits of sleep under the most unfavourable conditions; still, the sleep of young children must necessarily be a broken one in the single-room tenement dwellings of the poor of our large cities. This is an important unhygienic condition relating to mental development; for insufficiency of rest to the brain tends to failure of mental energy. The growing infant requires plenty of sleep; so also does the growing child, and especially is it so when the child is suffering from bodily ill-health or nervous irritability. When I was in Chicago recently I observed that all the children in the Special

School for Tuberculosis were made to lie in bed for an hour in the afternoon.

The question of nutrition in relation to mental development, ability, and efficiency is one that until quite recently was not properly considered by the authorities; for until the mother's health and her mode of feeding her offspring became a part of social reform, the most important step in relation to nutrition and mental development was left out. Statistics of malnutrition vary in different localities. My daughter has furnished me with statistics of two places—Willesden and Chester—and they show that not many children in these localities were suffering from imperfect nutrition when medically inspected. The minor ailments were the chief cause of trouble—viz. defective teeth, adenoids, large tonsils, defective vision, and especially parasitic head affections. Eye strain from errors of refraction may lead to nervous affections in children with a neurotic or neuropathic temperament—e.g. headache to epilepsy and migraine; adenoids and large tonsils are a very frequent cause of deafness and consequent mental dullness.

The extension of the meaning of education by collective responsibility to the bodily welfare of the child from birth onwards is one of the greatest steps made towards increasing the educability of the child when it arrives in the school. For further information, *vide* Appendix. We have seen that the factors underlying educability are first and foremost the germinal inborn potentialities derived from progenitors—Nature;

secondly, those conditions of Nurture which are favourable to the morphological development of inborn potentialities—viz. bodily nutrition, sleep, and stimulus.

The Health of the Teacher

The mental and bodily health of the child is intimately related to that of the teacher, and medical inspection of the teachers is only second in importance to medical inspection of the children, for a healthy mind in a healthy body is as essential for efficiency in teaching as it is in learning. The public and the education authorities should recognise that inasmuch as teachers are employed in a work of the greatest national importance they are entitled to such an adequate remuneration and limitation of hours of labour as will enable them to enjoy a normal, restful, and recreative personal and social life. The ill-paid and therefore ill-nourished, worried, tired drudge can have no *joie de vivre* to reflect to the child; instead from such a one, day by day, the children receive their moral and intellectual nourishment from a worn-out human machine, which monotonously and automatically grinds out wordy chaff of information instead of the ripe grain of knowledge, glowing with a sympathetic interest, that can arouse the good latent potentialities of the child, thereby creating joy and interest in its lessons. Again, force of character and will-power necessary for maintaining order and discipline demand good bodily

health and an adequate reserve of nervous energy; the value of the same cannot be over-estimated in the success of any occupation or profession, but especially is it essential to the teacher, as his occupation continually calls for all the attributes of a well-balanced mind in the exercise of self-restraint and continuous readjustment, as occasion may arise, in the moral and intellectual development of a large number of children each with its individual impressionable personality. If the health becomes seriously impaired, the teacher is either hypercritical and unsympathetic or else apathetic and dull, discipline is lost, and teaching degenerates to a labour, the only reward of which is the material support of a wretched and barren existence.

The Influence of Education on the Development of the Mind

The teacher is powerless to develop intelligence where there is an absence of the material basis of mind, or an inherent low functional value and ready fatiguability; so that sustained attention, necessary for the acquirement of knowledge, fails. The former condition is quite hopeless, the latter may not be due to inborn defects, but to bad nurture; therefore preventable and, in a measure, curable.

The object of education should be to establish physical, intellectual, and moral efficiency in the child by drawing out and developing the good

inborn qualities, by installing and fixing good habits, and by repressing, controlling, and preventing as far as possible the acquirement of bad habits. In the acquirement of good or bad habits early in life when the mind is most susceptible, imitation and suggestion play a most important part; thus an inborn virtue such as an amiable and confiding disposition may under the influence of bad companionship lead to the ready acquirement of vicious habits. The teacher has only a partial influence in forming character and education for efficiency. Home influence, good as well as bad, companions in school and out of school, chance and opportunity, all play their part in the general making of success or failure in the final product of education. Home influence is the most important factor in efficiency, especially in the formation of character; the individual efforts of good parents, especially of good mothers, cannot be replaced by the collective efforts of society in schools and institutions. Yet much may be done by health visitors and domiciliary visits of school nurses in improving the home conditions of the child, and thus helping the teachers in their work of education. When the home conditions are impossible for the child, the relief of the parents of responsibility for its care has been attended with marked success; so also the poor material furnished by waifs, strays, and orphans formerly dragged up in the workhouse has been made into more or less efficient material in the industrial schools and Barnardo's homes. Social

reform has thus made great progress in the interest of the child by the extension of the meaning of education. I have been much impressed by the growing interest teachers take in their pupils; especially have I had the opportunity of observing this in the teachers at special schools. They know of the home life of their pupils, and show interest in understanding the cause of the physical and mental defect from which the child suffers. It seemed to me almost pathetic that teachers with such intelligence, human sympathy, and untiring energy in their work should be entrusted with the almost hopeless task of trying to draw out from mental defectives initiation or efficiency. It is otherwise in the special schools for tuberculosis, deaf and dumb, and blind children; here there is educable material which will in future make for efficient service. The open-air schools for the treatment of tuberculosis which I visited at Birmingham made me exclaim: "Why, these children look healthier than the normal! Why not have all the children taught in open-air schools?" An alternative suggestion has been made to make use of existing school accommodation for the children from insanitary homes for day lessons, but to conduct them afterwards to a healthy open-air space, where sleeping accommodation is provided. An early supper and a long refreshing sleep would render the child more fit for the next day's schooling.

The special schools for the deaf and the blind yield gratifying results to the teachers, because

in the majority of cases the children are not mind-blind or mind-deaf; they are educable because the material basis of mind in the brain is there, and the teacher finds her way to the mind of the blind through the finger-tips and to the mind of the deaf through sense of sight. The deaf child, by watching the movements of the lips, is able to speak by imitating the movements. Do not these facts show the great importance of training the tactile-motor sense and the sense of movement (kinæsthetic sense) in our normal schools?

The kinæsthetic sense is one of the most important which can be cultivated; it is the essence of the *joie de vivre* in play, which is instinctive in children and animals; and not only do the feelings aroused in connection with it give pleasure, but they are stimulating to growth of body and mind. Every movement of the limbs leads to ingoing currents of nervous energy (*vide* Plate I, fig. 1). Bodily fatigue from exercise arises more from accumulation of fatigue products (that is, chemical substances) in the muscles than from exhaustion of the nervous structures; indeed, the nerves acting merely as conductors do not get fatigued, but the neurones as generators of energy, especially the nerve cells, are fatigued, both by accumulation of fatigue products and by exhaustion of nervous potential.

The Evolution of Association of the Eye and the Hand

A study of the association of the eye and the hand is of great interest in showing the reciprocal simultaneity in the development of the visual directive and the tactile-motor executive faculties. In the animal series it is not till we reach the primates (apes, anthropoid apes, and man) that we find dissociation of the fore limbs from progression; the nose is lifted from the ground and the sense of smell and capture of food by the mouth gives place to capture of food by the hand guided by vision. The primates are microsmatic, that is to say, the olfactory nerves and the structures of the brain subserving the sense of smell are relatively poorly developed, but the structures of the brain which serve the function of vision, hearing, and touch are largely developed. It is not till we reach the primates in the animal series that the eyes are set with their visual axes parallel, and that therefore these axes are capable of convergence; consequently by accommodation the image is always made to fall on the yellow spot. Moreover, it is not till we reach the primates that a yellow spot is found to exist. The panoramic vision of the macrosmatic quadrupeds is replaced in the primates by binocular stereoscopic vision. But with the development of binocular stereoscopic vision, there has simultaneously developed the stereognostic sense, or the sense arising by the association of the experiences of the visual directive and tactile-

motor executive faculties, by which the mind can recall the visual image of an object handled or touched. Every object seen is associated with the experiences of touching and handling it, and makes us conscious of its realities of form, of smoothness, of roughness, of hardness. A little reflection will show how great a part this association of the eye and the hand has played in the progressive evolution of the brain as an organ of mind.

Now some people have the power of visualising, that is, summoning to the *mind's eye* images to a remarkable degree, and all possess it to some degree. Yet as Galton truly remarks: "Our bookish and wordy education tends to repress this valuable gift of nature. A faculty that is of importance in all technical and artistic occupations, that gives accuracy to our perceptions and justness to our generalisations, is starved by lazy disuse, instead of being cultivated judiciously in such a way as will on the whole produce the best return. I believe that the serious study of the best method of developing and utilising the faculty without prejudice to the practice of abstract thought in symbols is one of the many pressing desiderata in the yet unformed science of education." This appeal of Galton emphasises the importance of educating the association of the eye and the hand.

The child has imagination, and it loves to picture in its mind's eye visions of the beautiful. What greater proof can we have of this than the universal popularity of Hans Andersen's fairy

tales, "Alice in Wonderland" and "Peter Pan." The child is naturally idealistic and romantic, and its character can be studied best in its ideals and play, because there is no repression. Now it is well to train a child to give expression to its ideas and ideals, not only by words, but by acts, especially by the hand, the instrument of the mind, and yet the mind's instructor.

In this country Mr. Cooke has been a pioneer in teaching free-hand drawing by children on proper lines; and those who are interested in this important branch of education should read "New Methods in Education," by J. Liberty Tadd of the Adirondack Schools.

The Order of Development of the Physiological Functions of the Brain in Relation to Education

It will be observed from what I have already said when dealing with the morphology of the brain and its development—that the earliest parts of the cerebral cortex to exhibit functional capacity are those areas which serve as the receptors of the organic and general body sensibility and the special senses. A very little time after birth the motor area is myelinated, and therefore prepared to react in response to sensory stimuli, whether coming from the body itself in the form of organic needs or from without in response to stimuli from the external world (*vide* Plate V, fig. 1). The former are fundamental to the preservation of the individual, for upon the

organic needs are based the desires which excite the brain, through the senses, to explore the external world in order to gratify them. This is well exemplified by observing that an infant at first conveys all objects, that it sees and grasps, to its mouth. A simple elemental sensation soon after birth becomes impossible ; for every simple sensation tends to reflex activation, and each phase in that motor reaction which occurs is immediately followed by incoming sensory stimuli registering in the mind the successive movements brought about (*vide* Plate I). At the same time each experience perfects the association of the sense of movement with the mental image of the sensation ; thus the memory of the visual image is associated with the memory of the movements of the eyes necessary for it to be clearly seen ; likewise the memory of the visual image of an object is associated with the memory of the movements of the arm and hand by which it was grasped. Now the muscular sense is combined with the active sense of touch ; but it is better to speak of it as the kinæsthetic sense, for this includes the sensation arising from the stretching of tendons, the movements of joints, as well as of movements of the muscles. All the sensory receptor spheres of the brain are associated with the voluntary efferent motor sphere (*vide* Plate VI, fig. 2), and every sensation in the infant tends to activation, that is motor expression ; for it is by handling and touching parts of its own body that it becomes aware of its own personality, and by motor reaction to sensory

stimulus it learns the reality of things in the world external to it; consequently with the progressive evolution of the child's mind there is constant sensori-motor association. Not only is there association of each sensory sphere with the motor and kinæsthetic spheres, but there is also an association of all the sensory spheres with one another; so that a simple sensory stimulus from within or without the body revives in the memory a complexus of previous sensory experiences which are termed "percepts." The perceptive faculty of associative memory of concrete images of previous experiences with elemental time and space relations and the acquisition of appropriate motor reactions under the influence of the will, is also possessed by all the higher animals; and while the infant is crawling on all fours like an animal, it possesses only these animal faculties of mind. As the child obtains the erect posture and the fore limbs are dissociated from progression, it begins to acquire the human faculties of forming concepts and of giving expression to them by speech, the primary incitation of which is hearing; and later writing, reading, and measurements of time and space, in which vision plays a dominant part, are acquired. As these human faculties are evolved, so the processes of abstract thought and reasoning by associative memory of symbols—particularly in a cultured and civilised environment—gradually tend to replace in the child associative memory of concrete images. I have already alluded to the importance of freedom from restraint to the

child's natural instincts of curiosity and play, and Mr. Edmond Holmes, in "What Is and What Might Be: A Study of Education in General, and Elementary Education in Particular," says: "There is nothing that a healthy child hates so much as to have the use of his natural faculties and the play of his natural energies unduly restricted by pedagogic and parental control." We should indeed recognise that one of the child's greatest assets is its childishness. It should be interested in its lessons because it enjoys them, and not to win prizes and rewards, which in a number of instances only indicates an ability to receive, retain, and retail information. Knowledge in later life will be its own reward, ignorance its own punishment.

Holmes asks: "Does elementary education, as at present conducted in this country, tend to foster the growth of the child's faculties?" According to Holmes the answer is an emphatic No! "For in the school, as I have sketched it, the one aim and end of the teacher is to prevent the child doing anything whatever for himself, and where independence is prohibited the growth of every faculty must needs be arrested, the growth of every faculty as of every limb and organ being duly and suitably exercised by its owner."

From what I have previously said it will be observed that perception and expression are interdependent, and an educational policy or system which does not make self-expression, in other words sincere expression, its aim, is neces-

sarily fatal to the normal psycho-physiological development of the mental faculties.

The kindergarten system introduced by Froebel, and lately modified and developed by Dr. Marie Montessori, is based upon sound psycho-physiological principles, such as I have outlined in the development of the structure and function of the brain. The Board of Education in England, recognising the importance of this work, issued, in October 1912, a special report on the subject by Mr. Holmes; it is probable that the study by Mr. Holmes of this system, the fundamental object of which is self-education by the pupils themselves, a system in which there is neither reward nor punishment of the ordinary kind, and in which there are no time tables, no set lessons, and no classes, led Mr. Holmes to write the book above mentioned—"What Is and What Might Be."

The first stage in the Montessori system, as would be expected from what I have just said, is the development of the senses, mainly touch, then sight and hearing; this is accomplished by various sorts of games and by drawing the attention of the child to the association of things, names, and ideas. Such operations are preliminary to writing and reading, but naturally lead up to both.

As Mr. Holmes says, the first impulse of the ordinary teacher is to tell a child how to do a thing which it has never attempted before; the second is to rush to the child's aid, who having been allowed to try his hand at something new,

is confronted by a difficulty and is in doubt as to his next step; the third is to correct his mistakes for him, instead of leaving him to correct them himself. Dr. Montessori in Mr. Holmes's words has "rediscovered" Froebel's master principle of "auto-education"; the teacher is the *director* of the spontaneous work of the child, "she is a *passive* force, a *silent* presence." Dr. Montessori employs an extensive variety of apparatus suitable for educational games by which the children are interested and stimulated to acquire knowledge, and her educational system is an original and practical expression of sound psychological principles; these principles are based upon the anatomical and physiological order of development of structure and of function of the organ of mind.

Little has previously been said in respect to the sense of smell and taste, but the cultivation of these senses is of more use than many people imagine; for they are a daily source of keen gratification; they frequently serve to revive pleasant associations and they are the best natural protector against unsound food, unwholesome drink, and vitiated air. It is a remarkable fact that most mineral and vegetable substances that are poisonous are acrid, unpleasant, pungent, or bitter, and readily excite nausea, disgust, and rejection from the mouth when tasted, likewise all foul and many poisonous odours excite nausea, disgust, and aversion; whereas pleasant tasting and smelling substances found in nature are usually wholesome and nutritious.

Pain and Pleasure in Relation to Mental Development

The associative memory of painful and pleasurable feelings plays an important part in mental development. The sense of well-being and pleasurable feeling is a vague state of consciousness clothed and enriched by perceptual and intellectual associated memories which we *desire* to experience again, and they form an accompaniment of the healthy activity of the functions of body and mind when not exceeding the ordinary normal powers of reparation that the organism possesses. The preservation of the individual and the species depends not only upon the gratification of the desires, but also upon the protection of the body from physical and chemical injury by pain; moreover, the senses of smell and taste are sentinels to the alimentary and respiratory systems, protecting them from injury, by exciting nausea and disgust or reflex acts such as coughing, sneezing, and vomiting. These are states of consciousness which there is *no desire* to experience again, and when associated with perceptual and intellectual memories their causes can be avoided.

There is evidence to show that if pain is felt in the optic thalamus the perceptual concomitants with which it is associated are registered in the cortex cerebri; for the optic thalamus is connected with every part of the cerebral cortex, the seat of associative memory and recollection. The cortex is not the per-

ceiver of pain, but the perceiver of the causes which produced it and by which it may be avoided. The cortex can be cut and stimulated without producing pain; not so the optic thalamus. If by associative memory of the conditions and agents which cause pain, revival of pain occurred, what would our state of mind be normally? Pain is the great protector of the body from injury. One of the trite sayings of Oliver Wendell Holmes was, "That clergymen and persons without wisdom consider pain a mystery; it is a revelation!" We can understand therefore the great biological significance of pain in evolution. Richet indeed is right in asserting that instead of considering pain as an evil we ought to consider it fundamental to human progress; for as instinct is blind, intelligence is necessary to avoid pain which by associative memory it foresees and prevents in innumerable ways, whether arising from direct bodily injury or a craving due to the non-gratification of the organic needs of the body—*e.g.* hunger, thirst, the desire for fresh air, for sleep, for exercise, for recuperation and repose after muscular or mental fatigue and for the satisfaction of the sexual appetite. It is not too much to say that the affective life or subjective feeling of the child as well as of the adult depends largely upon the organic sensibility (cœnæsthesia), the source and foundation of all stable perceptual associations and of the vast majority of habitual actions. It is necessary to remark that the subjective attitude of the in-

dividual determines the severity of pain felt, as much as the intensity of the stimulus. We know how an irritable state of the nervous system enhances pain, whether it be due to inflammatory conditions of the peripheral nervous structures, of the chains of neurones forming the transmitter to the seat of consciousness, or of the central receptor which in certain abnormal mental states (*e.g.* neurasthenia and hysteria) may evince hyperæsthesia or anæsthesia.

The Control of the Emotions and Inculcation of Good Habits

In the formation of character no problem in education is more important than the acquirement of self-esteem, self-reliance, and self-control; but this education of self, to be effective in the struggle for existence in our social organism, must be tempered by sympathy and unselfishness to others, for the essence of social evolution and progress is altruistic egoism. It is never too early to begin to inculcate in a child the habit of self-control; thus it should be taught to acquire the habit of control of the primitive emotions of anger, of fear, and of disgust in infancy, and to limit or repress their motor reactions; but their repression or suppression should in great measure be determined by the nature and intensity of the cause of the emotional disturbance. Crying and screaming of an infant is a protective appeal to the mother for relief of pain or the satisfaction of a natural

desire or organic need, but this natural expression of a physiological necessity may become the expression of a bad temper; thus a child, who learns that it can get its own way in obtaining something it desires against its parents' wishes, very soon contracts the bad habit of falling into a passion whenever it is thwarted. The indulgent mother, to stop the fits of crying, screaming, and outbursts of angry temper too often yields to the child's will, and gradually but surely a weakening in the development of self-control occurs, which has a profound influence upon the development of character; especially is this the case in a child with an inborn unstable temperament. The influence of education on self-control is well illustrated in the lines of "Childe Harold" where Byron doubtless refers to his own bringing up:

> I have thought
> Too long and darkly till my brain became,
> In its own eddy boiling, and o'er-wrought,
> A whirling gulf of fantasy and flame.
> And *thus untaught in youth to tame*,
> My springs of life were poisoned.

The emotion of fear is protective; the instinctive reaction is either flight or concealment; naturally therefore darkness is associated with this emotion, and it is not surprising that children and savages should have an inborn tendency to fear the dark. Seeing that there is this natural tendency of children to fear darkness, some discretion is required in overcoming the dread of a

naturally timid child to sleep in the dark, and harm may be done by too rigidly applying the principle of forcing it to go to sleep without a light, especially if it has become accustomed to one in its infancy. The habit should be gradually broken, if it has been contracted. Much injury is done to young children by ignorant nurses and servants by frightening them with stories of ghosts and bogeys. Indeed, the tempers and morals of many children have been ruined by mothers leaving the care of their children to ignorant and vicious nursemaids.

Another bad habit which may be contracted by the child in early life is an unnatural desire for sympathy ; too often an only child of indulgent parents, sometimes under the cloak of the possession of a fondly supposed æsthetic or artistic temperament is allowed to contract the habit of unreasonably soliciting sympathy whenever opportunity offers ; and the penalty in later life is paid by the unnatural development of the self-regarding sentiment, a precursor so frequently of functional, nervous, and mental disorders.

While it is highly desirable to train children to exercise control over the primitive emotions, it is essential that they should not be so suppressed as to injure the natural spontaneousness of the child. The natural expression of the emotions is motor reaction, and when emotions or passions are pent up by voluntary restraint they are apt to lead to exhaustion of mind and body.

The suppression of the manifestation of tears

and anger from fear of punishment, especially if the punishment does not fit the crime, may produce a sulky habit in the child; and this pent-up anger and fear may in later life tend to the formation of a character in which hatred and revenge find a suitable soil for development. By suppressing the manifestation of an emotion or passion it becomes continuous and contemplative. For as Shakespeare says:

> Give sorrow words: the grief that does not speak
> Whispers the o'er-fraught heart and bids it break.

A child in earliest infancy manifests by characteristic expression the emotion of disgust; this emotion and its instinctive rejection of bitter, acrid, and nauseous substances by spitting out and vomiting is protective in the highest degree; thus it is natural for a child to show signs of disgust and anger when nasty medicines or unpalatable food are given to it. But a child may acquire a habit of screaming and rejecting with tears and signs of anger wholesome food when it sees other food intended for adults. Here the child, owing to the initiation of a bad habit, is behaving contrary to the instinct of preservation, and the only course to adopt is to give it no food until its natural food is accepted. Too often, however, an indulgent or ignorant parent yields to the child, and very soon a bad habit is firmly installed, which may later be a determining cause of bodily ailments and weakened self-control.

Children are, like many animals, naturally

curious, and this instinct of curiosity is closely associated with the emotions of surprise and wonder. Curiosity in children manifests itself by inquisitiveness regarding the natural phenomena they observe and their causation; too often this instinct in which science has its roots is repressed by "don't ask questions," or some foolish commonplace answer is given to their inquiry, which upon reflection the child knows to be untrue. Every child is a natural philosopher, and all natural phenomena, the result of perception, that the child is fit and capable of understanding, should be explained, or the child should be told truthfully, "I can't explain the fact." It is, however, in my opinion a mistake to lead the young child too far into experiences which an adult alone can understand and appreciate in their full biological significance.

Sex and Education

It is an important fact to bear in mind in the education of the two sexes, that there is as radical a biological difference in the mind of the woman to that of the man as there is bodily difference, and this different mental attitude peculiar to sex shows itself especially in the contrast of emotional feelings and their manifestations; moreover, a woman is different intellectually; she has quicker perception and association of ideas, she deliberates less and arrives intuitively at a judgment quicker than a man. She has, however, less mental energy and power of will

than a man. Being constitutionally different from a man, a woman's physical and mental education, in order to bring out her noblest and best qualities, should not be identical with that of a man. I may here remark that co-education of the two sexes in adult life has not proved a great success. Just as a woman prefers a manly man and despises an effeminate man, so a man is attracted to a womanly woman and is repelled by a mannish woman; this is the natural consequence of sexual attraction, and should be duly borne in mind in the education of girls; the feminine charms and graces should not be sacrificed lightly by copying slavishly man's physical and mental development.

Still it is an acknowledged fact that social conditions prevent a very large proportion of marriageable women from fulfilling the natural functions of motherhood, and they have therefore only to consider their own individual life and its preservation. Education and intellectual development of women to enable them to earn their own living, and thus become efficient social units, will not make them any less capable of becoming good mothers, provided there is in their training ample scope for natural physiological development, and the normality of the reproductive organs is not interfered with by too strenuous mental or physical exercise. It is necessary to give a word of warning against girls being pressed at schools by night work and competitive examinations, just at the time when the reproductive organs are commencing to func-

tion and exercise a profound influence on the mind. Nor do I regard it as wise to overdo sports and games at a period of life when important physiological processes connected with the storage of energy and nutrition are called for by Nature in the preparation of its supreme effort of reproduction. Over-pressure at schools and competitive examinations at puberty and early adolescence is often due to the ambition of parents, but it not infrequently leads to a nervous or mental breakdown, especially if the child has an inborn neuropathic tendency.

A question of great practical importance is the teaching of sexual physiology in the schools; it is at present giving rise to much discussion whether it should be taught at all, and if it is taught at what age should the instruction be given, and, finally, by whom it should be given. Regarded as a scientific, sacred, biological subject, no harm can arise, only good, if the instruction is commenced at a time when the dawn of the passions and sentiments of sex is arousing in the mind of the boy or girl a new outlook on life. Without instruction youths and maidens may grope their way to knowledge in semi-darkness under dangerous social conditions, against which they ought to be forewarned by instruction. The prudery that covered up the most important problem of life is fast disappearing. Instruction in biology must, of necessity, include the study of reproduction in the lower animals, and such instruction in successive stages leads up to instruction of reproduction in man. The

problems of sex in relation to social questions and health could be imparted best of all to boys and girls just before leaving school. A great deal of suffering, misery, and disease might be averted if such teaching were given by men and women specially chosen on account of their knowledge, wisdom, and high moral character. It might be well to invite parents to be present at these lectures.

The Effects of Education upon Race, Class, and Sex

Man's nature does not change except by the very slow process of evolution in the struggle for existence and survival of the fittest. Self-preservation and propagation will always be the two biological factors determining the habits and conduct of individuals, whether considered singly or collectively; consequently, racial antagonism exists, and will continue to exist, in modern civilisations as it did in the past. If education of the masses has not yet brought about the millennium, signs are not wanting among the more highly civilised nations that education is influencing the thoughts and aspirations of mankind in such a way that war and conquest as a means of racial expansion and progress is coming to be recognised as "a great illusion" not only by those who are the mere pawns in the game, but also by the rulers themselves. As long as patriotism is not sacrificed, this is a good and hopeful sign. The uplifting of the masses of the

people by education, political freedom, and self-respect has undoubtedly led to class antagonism; and the demand by labour from capitalists and landowners of a living wage and a decent dwelling will have to be conceded. A man or woman of whatever class, if an efficient unit of society, has the right to demand the means whereby he or she may preserve bodily health and mental vigour and such conditions as will enable them, if they choose, to become parents and to be able to rear a family under healthy conditions.

Education of women must be held responsible for another cause of unrest; at first limited to the intellectual, it has grown and extended so that it is pervading all classes of women, and a sex war has sprung up. Is the cause of this purely a social matter concerning the preservation of the individual, and therefore based upon the exploitation of women's labour by man, or is it not largely connected with the other biological principle? Mr. Heape, in "Sex Antagonism," inclines to this view, as he says: "For my part I do not deny that economic and social laws are intimately concerned in the problem—indeed, I maintain they urgently need revision; but I claim that it is primarily a biological problem we are dealing with, that the violation of physiological principles has long preceded that of economic law, and that existing conditions cannot be clearly understood and satisfactorily dealt with until this fact is clearly recognised." "The existence of sex antagonism *per se* is sufficiently accounted for by the fact that the male and female are

differently organised and that Nature has set them different tasks to perform in conjunction with one another." How far do social conditions, usages, and customs of modern civilisation interfere with the natural aspirations of women and therefore lie at the root of this sex war, and how far would political franchise, when it is obtained, end the strife, is a question which the future alone can answer.

APPENDIX

MEDICAL INSPECTION OF SCHOOL CHILDREN

By Agnes Mott

Lady Sanitary Inspector and School Nurse to the City of Chester

The introduction of compulsory education led to the insistence by the authorities of a higher standard of school attendance.

The provision of a number of new schools replacing former inadequate arrangements with a view to improved school hygiene led to a demand for better hygienic conditions for the scholars.

Thus a stricter code obtained as regards cleanliness and the introduction of contagious and infectious disorders amongst children. Consequently a large number of children were constantly being excluded as a source of danger to others. The attendance officers and teachers then found it difficult to bring the attendances up to a sufficiently high standard.

It was grasped by some of the more far-seeing educationalists that much of the enormous expenditure on school buildings and the teaching staff was wasted upon a large number of children who were below the standard, mentally and

physically, and rendered unfit to respond to the lessons given to them.

Improvement in the physical condition of the child was essential to secure good educational results, and the institution of medical inspection was the initial step taken in promoting and maintaining the health of the child.

Sir George Newman states in his Annual Report to the Board of Education, 1912, p. 23: "The careful medical inspection of each individual child is the only sure foundation upon which preventive as well as remedial work of a lasting character can be established, and further that the medical examination of school children, if it is to be effective, must be sufficiently thorough and clinical."

"What is required is a careful and accurate study of each child if school hygiene, medical treatment, and education in its broadest sense are to rest upon sure foundations."

School doctors and school nurses are now largely appointed to deal with medical inspections at the schools, and the fruitful results obtained from diagnosis and treatment of abnormal physical conditions are encouraging the authorities to make further outlays upon improving and enlarging upon existing schemes.

Although there are comparatively few serious chronic diseases detected amongst the children, there are a large number of minor physical ailments requiring attention which, if neglected, may lead to grave disorders.

The system of examination usually adopted is

that of making not less than three periodic inspections of each school child; firstly, on admission to the school, secondly, at ten years of age, and, thirdly, at thirteen years of age before leaving school. The labour exchanges have a physical record of the child sent to them when the child leaves school, and are therefore able to choose the trade or occupation for which it is most suited.

In regard to the treatment of physical defects found in elementary scholars, it is the custom for the school doctor to send a notice to the parents notifying them of the defect and advising them to obtain treatment. The school nurse usually follows up the cases by domiciliary visits, and encourages the parents to obtain suitable treatment if they have not already done so.

A large number of children are known to be in a verminous or dirty condition at school; therefore special measures are taken to detect and remedy these conditions.

An improvement has in consequence been noted during the last few years, but it is improbable that this evil will be greatly reduced until improved hygiene prevails in the homes.

Verminous or unclean heads are still painfully evident in the schools, and the following figures speak for themselves:

London County Council	Children examined	Verminous or unclean heads
1912	64,251	15,221

Decayed teeth are very prevalent, and 75 per cent of the children are often found requiring

treatment. Defective vision also occurs in astonishingly large numbers, as also enlarged tonsils and adenoids.

In certain neighbourhoods contagious diseases amongst the scholars are common—such are ringworm, scabies, ophthalmia, and impetigo.

Outbreaks of infectious diseases such as measles, whooping cough, chicken-pox, mumps, scarlet fever, and diphtheria also occur. Measles appears to have a disastrous influence upon the subsequent health of the child when complications ensue; and the seriousness of these after-effects is not sufficiently realised. A large percentage of deaths amongst infants is due to this cause.

The disease is most infectious in its early stages under the appearance of a cold, and unfortunately the premonitory signs are frequently ignored, and the child is allowed to attend school. Certainly there do not appear to be adequate arrangements by any authorities for the treatment of this disease.

In the exclusion and treatment of scholars suffering from illness or physical defects, difficulties are sometimes encountered through the system of the Board of Education of awarding grants based on the number of attendances made at the schools. A larger grant is available when children are not absent from school for treatment, and the above system therefore has certain drawbacks.

Parents are frequently averse to the treatment of defective vision, carious teeth, and enlarged

tonsils or adenoids—on the grounds that it is an unnatural interference with the decrees of Providence and a breach with the past—when these defects were not regarded as of any importance.

The education committees have now obtained powers to provide glasses for children's sight at a reduced cost to the parents, and in some towns dental treatment is also provided in the same way, fully qualified dentists being made responsible for the condition of the children's teeth.

The provisions for treatment by the education authorities are, however, in most places inadequate, and unsatisfactory arrangements still exist. The large number of children, for example, in London, who were sent to the general hospitals with minor ailments led to the award of grants in lieu of treatment. But there is much to be desired in the method and organisation of this mode of treatment.

Hospitals have a sufficient number of serious cases to deal with, and it entails confusion when a large number of children with ailments such as conjunctivitis or ringworm have to be dealt with. Again, a number of formalities have to be gone through before presenting a child for treatment, and this entails friction and delay.

The loss of time involved to the parents, when they have to spend long hours in out-patient departments and other inconveniences arising therefrom, make hospital treatment more difficult for them to carry out than necessary.

Another drawback to the hospital system is the difficulty of watching the progress of treat-

ment, owing to lack of contact with the medical advisers. In smaller towns, however, this system has been worked with success.

A great deal of work in "following up" cases is done through the medium of care committees, and without some organisations of this character a large number of children would probably remain untreated.

The difficulties in obtaining treatment would probably be lessened by the institution of school clinics.

School clinics have the following advantages:

1. They form a natural continuation and completion to the work of medical inspection, and come under the direct control of the school doctors.

2. They can be put into direct co-operation with the local health authority, and in many places a conjoint appointment of Medical Officer of Health and School Medical Officer is made.

3. It is more in harmony that the doctors diagnosing a case should, if desired, have the power to prescribe treatment.

4. *Treatment can be made efficient* without the before-mentioned difficulties; it is then reasonable to bring pressure to bear upon the parent when he neglects to make use of the advantages offered in order that the child may enjoy an improved physique and education.

5. The initial expense is not to be considered in comparison with the expense entailed on Poor Law Authorities and others in after-years. For so many of these small defects become aug-

mented when untreated, and frequently engender serious disorders, causing inefficiency and incapacity ; these, in their turn, produce unemployment and the wastrel.

A great advance has been made in the realisation of the importance of nutrition, and, in consequence, free meals may be provided to needy scholars by the education authorities.

When a suitable diet is given, this makes a considerable difference in the physique of a child, and it is often found that during the holidays the same child deteriorates and becomes emaciated owing to the lack of sufficient nourishing food in the home.

The provision of swimming baths also affords a stimulus to the youngsters in the way of healthy exercise and improved cleanliness. Playgrounds have been enlarged, and instruction in physical exercises is given, and the children are taught to expand their lungs in singing.

Thus most of the handicaps to the children's physical well-being are being removed in school life. Cleanliness, light, and ventilation are carefully considered in the majority of schools, and the education authorities erect new schools where the old buildings are considered hygienically inadequate. But it is of little avail to promote the cleanliness and physical well-being of the children when their homes are in such direct contradiction to the conditions prevailing at the school.

A large amount of slum property still exists in every city, and it cannot be denied that the

housing-problem remains the most pressing social problem of the day.

There is no doubt in the minds of all who have engaged in social work that impaired physique is most common amongst those who live in overcrowded slums.

Another problem which directly bears on the housing of the working classes is the question of the living wage. Without a satisfactory solution of this important question, decent conditions of life are unobtainable.

Thus it is found that the hygiene of school children depends to a great extent on the circumstances of the home. Infantile mortality during the first year of life has been greatly reduced by the efforts of local health authorities and the institution of health visitors and baby welcomes. But it is a pity that there is a gap in which the child remains without medical supervision before entering upon school life. It is generally felt that a good many of the defects found at the age of five years could have been prevented, or at any rate remedied, by suitable treatment previous to entering the school.

Many children surviving the first year of life are nevertheless in a delicate and enfeebled state of health, and require special attention.

The incidence of rickets is most frequent in the second year, and diseases such as measles and whooping cough are generally most fatal after the first year and before the fifth.

Dr. Forsyth, of Charing Cross Hospital, has recently opened a clinic for children under school

age, under the auspices of the Westminster Health Society; and the following returns of the commoner preventable defects during each of the first five years show an economy would be effected were these children kept under medical supervision during that period.

	Years 0–1	Years 1–2	Years 2–3	Years 3–4	Years 4–5
	per cent	per cent	per cent	per cent	per cent
Teeth defective .	—	2·6	18·1	34	63·6
Tonsils enlarged	—	7·8	16·9	24	26·9
Adenoids present	1·5	10·4	22·9	38	33·3
Rickets . .	13·0	25·9	9·6	8	3·0
Imperfect diet .	49·6	22·8	6·0	—	—

Total number inspected = 374

London County Council Infant Schools

Number inspected = 7,533

		per cent
Teeth defective	5,293	70·5
Tonsils enlarged . . .	920	12·3
Adenoids present . . .	826	11·0
Rickets	—	—

Special Schools

Another fruitful result of medical inspection has been the institution of special schools. A certain number of children are unable through physical disabilities to attend at the ordinary school, or are in too delicate a state of health to profit by the ordinary routine of school life. For

these special attention is required, and an entirely different syllabus is drawn up for them, in which handicraft plays a large part. Intervals of rest and refreshment are allowed, the school hours are shorter, and highly sympathetic, cultured teachers are chosen, who seem to obtain wonderfully good results as regards the responsiveness of the children to the teaching. The classes are, as a rule, small in number, thus securing individual attention. Great pains are taken to watch over the physical condition of the children. An ambulance fetches them, if necessary, to and from school, and during class hours their state of health is carefully noted. If anything is amiss, they are advised to obtain medical help, and frequently assistance is given in the way of obtaining surgical apparatus for cases of cripples.

The Invalid Children's Aid Society also does valuable work in this direction; and in London a representative of the Society frequently visits these special scholars.

As a rule school life is a great blessing to these poor children, lifting them from their sordid surroundings and improving their physique.

Tuberculous children should be kept under continual observation, and pre-tuberculous children—that is to say, those who have the tendency towards the disease—also require especial care.

For the treatment of such cases, exclusion from school is not always desirable, as home conditions may not be satisfactory. Unless the child is a source of danger to others, attendance at school is advisable. Open-air schools form the

ideal for these children, but when these are not available Sir George Newman states in his Annual Report to the Board of Education, 1912 :

" Attendance at the ordinary school, especially if a playground class and a modified curriculum can be arranged, with, if necessary, the provision of free meals, may prove a much more useful substitute for attendance at the open-air schools than the relative freedom of home life, accompanied as it often is by domestic drudgery."

The question of providing suitable treatment and education for tuberculous children is coming to the fore, and it is to be hoped that the number of institutions and special schools will be increased in the future.

Residential schools are desirable for phthisical children (unless the home environment be suitable). Day open-air schools are advisable for suspicious or susceptible cases, besides those that are known to be phthisical.

Successful results have been obtained in the existing types of these schools.

At present a large number of children suffering from tuberculosis and requiring prolonged residential surgical treatment in institutions (such as Sir A. Treloar's Home for Crippled Children and Mrs. Kimmins' Guild of the Brave Poor Things) are unable to obtain such a boon.

Special schools for mentally defective and nervously afflicted children are also in operation.

These are most necessary not only for the welfare of this class of child, but in view of

the fact that the ordinary standard in the elementary schools is far beyond their grasp. Where mentally defective schools are not provided, it frequently happens that children of thirteen and fourteen years of age are found in the lowest standards of the ordinary school, and the result is that the teachers are handicapped in their work of instructing the normal intelligent scholars. Moreover, it is quite unsatisfactory to the backward child, who is made a butt of by the younger intelligent children, making him hopeless in his helplessness. Again, some of these children who are deficient in intelligence and control are not lacking in animal propensities, and their mingling with younger children is therefore not desirable.

At the end of ten years of school life they are often unable to read their letters or count the number of pence in sixpence, or tell you how many days there are in a week. And although the teachers realise the futility of the task, and the parents are compelled to send them to the school, the education authorities are still wasting an enormous amount of money on them with an unsuitable curriculum.

Special schools are now being multiplied in order to segregate these children and to provide them with suitable discipline and instruction. The Mental Deficiency Act will further improve the arrangements for their control. Special schools have on the whole been very successful, particularly the physically defective schools. They have indeed indicated how teaching in the

ordinary schools might in many ways be improved. Thus they have shown:

1. The value of reducing the number of children in a class, thereby securing them individual attention.

2. The value of limiting the number of subjects taught, thus allowing the teacher more opportunity of specialisation and the pupil more opportunity of getting a thorough knowledge. It appears to be the general opinion that the elementary schools tend to convey a smattering of a large number of subjects, producing confusion and lack of thoroughness in the attainments of the pupils.

3. The value of handicrafts in training the child in quickness of perception and in preparing him for learning a trade in after-years.

4. Lastly, the value in removing or lessening physical hindrances, in order that the receptiveness of the child may be improved.

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