The Neuropathic Inheritance. By F. W. MOTT, M.D., F.R.S.

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Insanity and the Neuropathic Inheritance.

There are individuals born of mentally and physically sound stocks that no acquired conditions—*e.g.*, disease, drink, poisons, engendered within the body or taken in from without, head injuries, emotional shock, distress, and even profound misery and destitution combined—can render insane. There are others, and these are in most cases derived from a neuropathic stock, whose mental equilibrium may be disturbed by any one of these conditions, or even without any apparent cause, except the physiological conditions, appertaining to the functions of the sexual glands at puberty and during adolescence, the puerperium, lactation, and the climacteric period of women. Between these two extremes are all gradations of mentality from the congenital imbecile and the insane adolescent dement at one end of the scale to the potential sound mind and body that no combination of acquired conditions can render permanently insane. Maudsley, in his *Pathology of Mind*, has truly said: "A person does not inherit insanity, but a tendency or predisposition to it; and secondly, the tendency is inherited from the stock, and not from any particular development of it in the parentage. It is easy to understand that it is not in special individual outcomes, but in the foundation of the family nature, that we must search for the foundation of insanity." Following this wise advice, every case of insanity should be regarded as a biological problem, and the study resolves itself into the acquirement of a knowledge of what an individual is born with—nature—and what has happened after birth—nurture. The former can only be approximately ascertained by the study of the ancestral stocks, requiring a careful inquiry and analysis of the family histories of the members in the direct line, and if possible of the collaterals. By careful attention and inquiries many important facts in respect to the transmission of a neuropathic taint can be obtained. It must always be remembered that the neuropathic tendency may be manifested in different members of the stock in different ways.

Temperament and Heredity.

Just as the bodily features are transmitted from one generation to another, so is the temperament. The inborn raw

material of character is the complex sum total of the fixed and organised characters of the species and the sex, modified by special racial and family characters. The former are dependent upon complexes of primitive states of feeling and cognition based upon the appetites and desires and the appropriate instinctive reactions for their satisfaction, thereby ensuring the preservation of the individual and the species. The instinctive reactions are associated with concomitant primitive emotional states of feeling and objective manifestations peculiar to the sex and the species. The oldest phylogenetically, they are common to all human beings and are the mainspring of all human action, and this fact has been poetically expressed by Schiller in the following lines:

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

The special racial and family characters are of later development, therefore are far less fixed, stable, and organised in the nervous system, consequently are more liable to mutation. A child is born into the world with inborn immutable and mutable characters derived from these genetic sources; of the importance of the inborn characters in future conduct there can be no doubt; in proof thereof I need only remind you of Galton's remarkable inquiry into the history of twins. He found that similar twins (developed from one ovum and therefore identical germ-plasm) living in a different environment 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 with dissimilar germs.

Again, Galton, although he formulated a law of ancestral inheritance which appears to be contradictory to the accepted Mendelian law, certainly recognised that the law only applied to masses of people, and not to individual cases, for he said: "Though one half of each child may be said to be derived from either parent, yet he may receive a heritage from a distant progenitor which neither of his parents possessed as personal characteristics."

Galton also made a statistical inquiry into the inheritance of good and bad tempers, and his conclusions were that one set of influences tends to mix good and bad tempers in a family at

haphazard; another tends to assimilate them, or that they shall all be good or all be bad; a third set tends to divide families into contracted portions. Moreover, he showed that there is always a tendency to revert to the normal average of the race—the law of filial regression. The older and more fixed a character is, the more liable is it to this law of filial regression.

A study of the neuropathic inheritance generally accords with Galton's inquiries on tempers. Still, the subject which is of paramount importance and interest in heredity now is: Can Mendelism be applied to human characters?

Mendelism and the Neuropathic Inheritance.

Professor Pearson, while entirely admitting segregation of unit character, says: No evidence exists of Mendelian proportions occurring in the transmission of obvious human unit characters—*e.g.*, pigment and absence of pigment (albinism). Professor Bateson does not affirm that it has *been proved* for human characters although he believes that it exists, for he says: "Organisms may be regarded as composed to a great extent of separate factors by virtue of which they possess their various characters or attributes. These factors are detachable and may be recombined in various ways. It thus becomes possible to institute a factorial analysis of an individual."

How far such analysis can be carried we do not yet know, but we have the certainty that it extends far, and ample indications in supposing that we should probably be right in assuming that it covers most of the features, *whether of mind* or of body, which distinguish the various members of a mixed population like that of which we form a part.

From such a representation we pass to the obvious conclusion that an individual parent is unable to pass on to offspring a factor which he or she does not possess. Since those individuals only which are possessed of the factors can pass them on to their offspring, so the offspring of those that are destitute of these elements (nulliplex) do not acquire them in successive generations, but continue to perpetuate the type which exists by reason of the deficiency.

Dr. Weekes and Dr. Davenport have recently published a remarkable paper on "The Inheritance of Epilepsy," which they

claim shows Mendelism in the inheritance of this disease and imbecility. It is a research of great value apart from theoretical

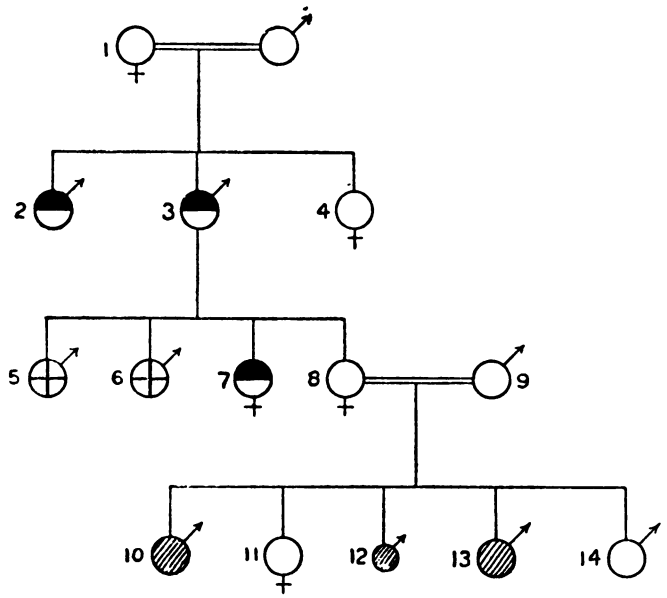

FIG. 1.—The above pedigree shows the transmission of insanity, immorality and violent temper. No. 1, the grandmother, was immoral; was found in bed with another man by her husband and son. Of her children, No. 2, an engine-driver, was "a man of violent temper who smashed things on a wholesale scale at home. He died with the delusion that he was going to heaven on the foot-plate 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.

considerations on account of the number of pedigrees recorded, but it appears to me to be open to several criticisms. Schuster,

https://doi.org/10.1192/bjp.59.245.222 Published online by Cambridge University Press

in a review, thus sums up the paper: "The inheritance of epilepsy and feeble-mindedness can be briefly stated as follows: Such very different conditions as epilepsy and feeble-mindedness must indicate some essential difference in the germ-plasm, and the tables which the authors produce show a distinct tendency towards the specific inheritance of these two characters separately; thus the proportion of children who are epileptics born of parents who are both epileptic is higher than when one parent is epileptic and the other feeble-minded, and considerably higher than where both are feeble-minded." It seems to me that there is an inherent fallacy in assuming that epilepsy and feeble-mindedness can own the same cause—*viz.*, an absence in the gametes of one and the same germinal determinant or specific factor.

"Dr. Weekes assumes the presence in the zygote of a particular factor or determiner necessary to ensure normal development. If it is absent, feeble-mindedness or epilepsy will be the result. Individuals in whom it is absent are called 'nulliplex'; according to the older terminology they would be styled pure recessives or homozygous with regard to the absence of this particular factor.

"The term 'simplex' is used to describe the heterozygote. Simplex individuals are said to possess an intermediate mental status, though some are apparently normal. It is nowhere precisely stated what are the symptoms of the 'intermediate mental states.' But the majority of persons classified in the tables as simplex are either alcoholic or neurotic. Persons who are really normal are called duplex. They have the normal development determiner twice over or are homozygous with regard to its presence." If this theory be correct, as Schuster remarks, then when nulliplex mates with nulliplex one would expect to find the offspring all nulliplex. In other words, the children of parents who are both feeble-minded or epileptic should be all feeble-minded or epileptic themselves. His own tables, however, show this not to be the case. When the Mendelian proportions are not borne out the authors endeavour to explain the fact in various ways: thus when the nulliplex feeble-minded and epileptic offspring are in excess of expectation the excess is accounted for by parental alcoholism. Schuster points out another and more obvious explanation—*viz.*, the manner in which the material was collected, which had the effect

of ensuring at least one epileptic in almost all the fraternities investigated.

Bateson has recently said: "It should be explicitly stated, however, that in the case of the ordinary attributes of man we have as yet unimpeachable evidence of the manifestation of this system of descent for one set of characters only—namely, the colour of the eyes. Moreover, if the evidence as to normal characteristics of man is defective, which, in view of the extreme difficulty of applying accurate research to normal humanity, is scarcely surprising, there is in respect to numerous human abnormalities abundant evidence that a factorial system of descent is followed."

This may be true for certain well-defined abnormalities, but as applied to the inheritance of the neuropathic tendency Mendelian proportions cannot be shown, according to my experience, and this is not surprising, considering the many forms in which it exists; and even if we take epilepsy, which is perhaps the most easily determinable of all conditions, yet there must be many undiscovered forms which would elude even an expert inquiry concerning the members of the stock affected.

The Neuropathic Inheritance.

"Like tends to beget like," but a collection of statistics and pedigrees merely relating to the existence in members of a stock of certified insanity or "fits," or weak-mindedness, is quite inadequate for scientific purposes, as the neuropathic predisposition manifests itself in many different forms, and it is necessary to know something of the temperament and conduct of all the members of a fraternity and as many of the stock as possible to make scientific deductions of value; and this requires time and patient investigation by a skilled person. It is very important to seek the first stages and less obvious condition of degeneration in the stock.

Morel, who studied this question more than fifty years ago, pointed out that nervous irritable weakness, the neurotic temperament, neurasthenic predisposition, may be the first evidence of degeneration of a stock. The inborn morbid temperament may be manifested in a variety of ways by the behaviour and conduct observed in various members of the stock. The signs of degeneracy which may be exhibited are

self-centred narrow-mindedness in religious beliefs, fanaticism, mysticism, spiritism, an unwholesome contempt for traditional custom, social usages, and morality, a vain spirit of spurious art and culture, a false, self-loving vanity in the pursuit of a sentimental altruism, or by eccentricities and anti-crusades and perversions of every kind, the intelligence being well preserved; such signs of degeneracy are often combined with talent and even genius, especially of the constructive imaginative order; but the brilliant intellectual qualities of a degenerate are generally associated with either a lack of moral sense or of sound judgment and highest control. Nevertheless, these neuropathics often serve a useful purpose by their disregard of tradition and social usages. Time, chance, circumstances and opportunities play an especially important part in moulding and determining the career of a neurotic stock; circumstances and environment may favour one member and he rises on the tide of fortune to an eminent position, whereas another, unfortunate or less fortunate, but with a similar inborn temperament, dies in an asylum or commits suicide in despair.

Genius and the Neuropathic Inheritance.

The genius of imagination of the prophet, the poet, the artist, the patriot, and the philosopher, and lust for action of the world's great leaders of men, are so frequently associated directly or indirectly with the neuropathie taint, that Dryden's lines have become a recognised truism:

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

The ancients recognized the close association of genius and madness. "All the greatest benefits of Greece have sprung from madness," said Pliny; "there is no mind without a mixture of madness," said Aristotle; he also stated that under the influence of congestion of the brain there were persons who became great poets, prophets, and sybils. (*Problemata*, sec. xxx.) How true this is may be gathered from the fact that the world's history has been made by men who were either epileptics, insane, or born of a neuropathic stock. Alexander the Great, Julius Cæsar, Napoleon, Peter the Great, Frederick the Great, Pitt Earl of Chatham, and Mahomet. The Apostle Paul,

Martin Luther, Emanuel Swedenborg, and a host of names of lesser fame may be recalled. When we turn to the poets—and I will content myself by referring to the English poets—we call to mind the names of Cowper, Wordsworth, Byron, Burns, Chatterton, Thomson, who were either insane or possessed the neuropathic temperament; in fact, that mutation of temperament from the "honourable ordinary" which tends to genius may also lead to insanity in some members of the stock, and not infrequently to the combination of genius and insanity in one individual. We do not know how it comes about that a genius springs up from an unknown source; with a meteor-like flash he appears and disappears. The imaginative faculty may be artificially stimulated by drugs and alcohol. De Quincey is said to have derived his imagination from the opium habit he had contracted; Hartley Coleridge likewise; and it is said that the *Ancient Mariner* was the result of dreams or hallucinations due to opium. But it is the temperamental inheritance which is essential for poets such as Byron, Wordsworth and Burns; they were born and not made, nevertheless their history shows that they possessed the neuropathic temperament or inheritance.

The influence of Nature and nurture on the mind of Byron can be best divined by his own description in *Childe Harold*:—

> "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."

It is said that Byron was subject to attacks of epilepsy; the most trifling circumstances would cause him to swoon. He had seizures with convulsions. This noble poet was the child of passion, born in bitterness and nurtured in convulsions. His maternal grandmother suffered from melancholia and committed suicide; another relative took poison. His mother was eccentric. His father, who was known as "Mad Jack Byron," committed suicide. So that there was a marked neuropathic taint on both sides in the progenitors of this greatest of poets.

Charles Lamb's father was insane, also his sister. Dorothy Wordsworth, the sister of the poet, died insane; his daughter Catherine suffered from epilepsy, and another is said to have

suffered with periodic insanity. Pope's mother suffered from senile dementia. Dean Swift's uncle died insane. James Thomson's father suffered from paralysis; his mother from melancholia. Cowper inherited insanity from both maternal and paternal stocks; he was insane, and several times attempted to commit suicide. In a letter to Lady Hesketh he says: "Could I be translated to Paradise, unless I could leave my body behind me, my melancholy would cleave to me there." His descriptive account in his autobiography of his feelings is a remarkable picture of depressive insanity.

Many of these poetic geniuses suffered with the pangs of indigestion, embittered by the pangs of poverty and neglect, and their fame is posthumous. Burns, writing to a friend, said: "Canst thou not minister to a mind diseased? Canst thou speak peace and rest to a soul lost in a sea of troubles, without one friendly star to guide her course, and dreading that the next surge may overwhelm her? Canst thou give to a frame, trembling alive to the tortures of suspense, the stability of a rock that braves the blast? If thou canst not do the least of these, why wouldst thou disturb me in my miseries with thy inquiries after me?"

From early life Scotland's immortal poet was subject to a disordered stomach, a disposition to headache, and irregular action of the heart. He describes in one of his letters the horrors of his complaint: "I have been for some time pining under secret wretchedness. The *pang of disappointment*, the *sting of pride*, and some wandering state of remorse settle on my life like vultures when my attention is not called away by the claims of society or the vagaries of the muse. Even in the hour of social mirth my gaiety is the madness of an intoxicated criminal under the hands of an executioner. My constitution was blasted *ab origine* with a deep, incurable taint of melancholy that poisoned my existence."

These revelations make one think of the truth of what Nietsche exclaims: "Who would dare to glance at the desert of the bitterest and most superfluous agonies of spirit in which probably the most productive men of all ages have pined away?"

There can be no question but that the morbid irritability which many men of genius have manifested was but a defect of bodily derangement upon a sensitive mind. Byron, in one of his letters, said: "I am suffering from what my physician terms gastric irritation. My spirits are sadly depressed. I have

taken a brisk cathartic, and to-morrow Richard will be himself again."

It is recorded that Voltaire and an Englishman, after a long conversation on the evils of this world, made a compact to die together the next day. The Englishman appeared and expected Voltaire to keep his promise, but the cynical genius thus expressed the change of his mental attitude: "Ah! monsieur, pardonnez-moi, j'ai bien dormi, mon lavement a bien opéré, et le soleil est tout à fait clair aujourd'hui."

The fame of immortals is too often posthumous, for at all

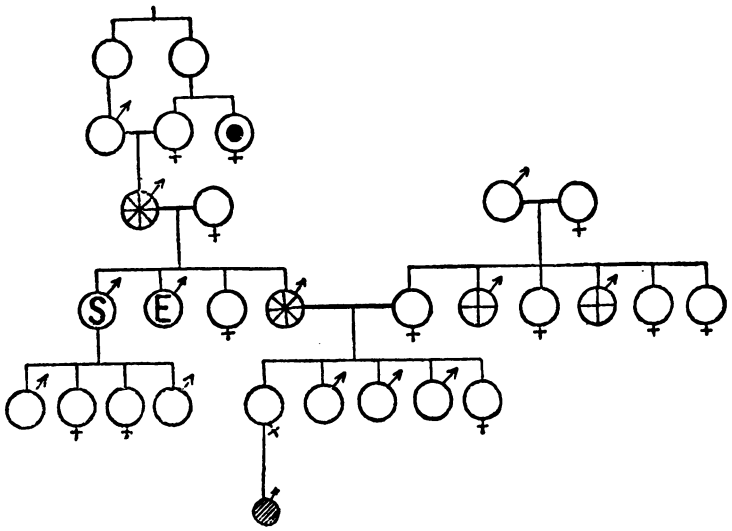

FIG. 2.—A pedigree, illustrating the marriage of first cousins. A genius was the result; he married a healthy woman, and their family consisted of an eldest son, a suicide; a second son, an epileptic; a daughter, healthy, unmarried; and a son, a genius. This man was a genius, but had an extremely well-balanced mind; all his five children are healthy in spite of collateral inheritance on both sides. Circles with black centres, physically unsound. Circles in quadrants, alcoholism. Circles in octants, genius.

periods in history a new religion, social progress, or even scientific advancement which overthrows established customs, usages, and traditions, have been too often regarded by the mass of the people either as works of the devil, of wicked men, or of madmen. Bacon, in his *Advancement of Learning*, is almost prophetic of his own fate, when he says: "The doctrines in greatest vogue among the people are either the contentious and quarrelsome, or the showy and empty; that is, such as

may entrap the assent or lull the mind to rest, whence, of course, the greatest geniuses of all ages have suffered violence, whilst out of regard of their own character they submitted to the judgment of the time and the populace. And thus, when any more sublime speculations happened to appear, they were commonly tossed and extinguished by the wrath of popular opinion."

Degeneracy and Successful Selfishness.

How often may it be observed that an apparently sound stock may in reality be unsound. Successful men in the eyes of the world may be really degenerates; not infrequently so-called self-made men form the first step in the process of degeneration. The selfishness and meanness or the cunning avarice and moral guile by which they have succeeded in selfishly amassing a fortune for their children to spend selfishly is the first evidence of degeneracy; but whereas the parents, to gratify their selfish desires, succeeded by work and abstemiousness, the children, possessing the same selfish instinct, with no need to work, and supplied with abundant wealth, acquire vicious habits and criminal propensities, and not infrequently terminate their careers in the madhouse or prison.

I have often found in the collecting of pedigrees the association of insanity and suicide in a stock preceded by, or associated with, the existence of individuals possessing the melancholic, suspicious, brooding, self-centred, hypochondriacal temperament; and it is not uncommon for suicide of one or more members of the stock in successive generations to occur. Associated with these temperamental evidences of degeneracy of a stock may be chronic alcoholism, dipsomania, hysteria, hypochondriasis, exophthalmic goitre, neurasthenia, psychasthenia, migraine, *petit mal*, or neuroses of an epileptic character, often unrecognised, because not manifesting fits of the major form of the disease. In searching for the neuropathic tendency there are, therefore, many possibilities of missing the inborn factor of a neurosis or psychosis though a careful inquiry be made, even when aided by intelligent co-operation on the part of the friends.

The Investigation of Relatives in the London County Asylums.

I will now pass on to a summary of the work which has been done in the Pathological Laboratory on heredity in relation to

insanity. Four years ago I initiated a card system of relatives who are at present, or have been, in the London County asylums. The reason for doing so was to see if the anatomical features of the brain—the organ of mind—showed, like the physiognomy, features of resemblance in the fissures. Dr. Edgar Schuster has carefully examined and reported on the brains of a mother and daughter and of two brothers, and in a long and valuable communication has demonstrated the many points of similarity that exist. Since there is a correlation of structure and function throughout Nature, we may presume that this affords an indication of a resemblance in the raw material of mentality in members of the same family.

Table showing Number of Cases reported from each Asylum.

Asylum.	Died.		Discharged.		Transferred.		Resident.		Total.		Total.
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M. and F.
Banstead . .	63	55	30	40	5	3	74	66	172	164	336
Bexley . .	48	61	39	47	7	8	117	113	211	229	440
Cane Hill . .	37	31	15	19	11	7	52	108	115	165	280
Claybury . .	55	67	38	57	10	17	81	125	184	266	450
Colney Hatch .	93	88	57	71	4	7	103	142	257	308	565
Hanwell . .	51	48	34	60	7	5	63	136	155	249	404
Horton . . .	39	27	21	27	10	8	83	101	153	163	316
Long Grove . .	12	9	25	33	3	5	64	88	104	135	239
The Manor . .	—	13	—	11	—	2	1	44	1	70	71
The Colony . .	2	—	1	—	3	—	9	2	15	2	17
Total . .	400	399	260	365	60	62	647	925	1367	1751	3118

Table showing Proportion of Deaths and Recoveries amongst "Relative" Cases.

	Discharged.	Transferred.	Died.	Resident.	Total.
Males . .	260 = 19·0 *per cent.*	60 = 4·4 *per cent.*	400 = 29·2 *per cent.*	647 = 47·3 *per cent.*	1367
Females .	365 = 20·8 *per cent.*	62 = 3·5 *per cent.*	399 = 22·7 *per cent.*	925 = 52·8 *per cent.*	1751
Total .	625 = 20·0 *per cent.*	122 = 3·9 *per cent.*	799 = 25·6 *per cent.*	1572 = 50·4 *per cent.*	3118

https://doi.org/10.1192/bjp.59.245.222 Published online by Cambridge University Press

From a few hundred cases at the commencement of the inquiry the list has rapidily increased until it has now reached 3,118 cases. This has involved a vast amount of work, and I wish to express my indebtedness to all the superintendents and medical officers, to the Clerk of the Asylums Committee and his staff, and to my assistants, especially Mr. Mann, for the assistance they have afforded me in this inquiry. It would take far too long a time to give more than a summary of the results obtained. There is yet a good deal to be done, but I think the following conclusions may be arrived at:

The 3,118 cases are made up from 1,450 families. At the present time in the London County asylums there are 725 so closely related as parents and offspring, brothers and sisters. *À priori*, this, to my mind, is striking proof of the importance of heredity in relation to insanity, for we cannot suppose that 20,000 people of the four and a half millions of people in the County of London brought together from some random cause would show such a large number closely related as 3·6 *per cent.* The large number of cases from this asylum probably represents the proper numbers in the other asylums, although it may be remarked that at Colney Hatch all the Jews are housed, and the number of relations among the Jews is proportionally considerably in excess of the Christian population, in spite of the fact that they are mostly aliens. There can be no doubt that the Jewish race is more liable to neurasthenia, and the neuropathic inheritance is more commonly met with than among Christians.

Comparative Statistics of Heredity in Asylum and Hospital Cases.

My late house physician, Dr. Thomas, carefully investigated and compiled the pedigrees from thirty-two of my hospital patients admitted for various diseases. There were in these pedigrees 1,000 living representatives and 250 died; there were eight who had been in asylums, and in eight others fits were chronicled. Two of the pedigrees furnished nearly all the cases of insanity and epilepsy, but these two patients were suffering from nervous disease. One was a patient suffering from neurasthenia, and in the pedigree there were members who suffered from epilepsy, migraine, insanity, hysteria, deaf-mutism and imbecility, significant of a neuropathic taint in the

ancestral stocks; and the other was a patient suffering from exophthalmic goitre, and there were several neuropathic members in this stock. I have ascertained that a far greater number would be found in the stocks of any thirty-two insane patients.

Analysis of 3,118 *Related Cases* (*Instances of Two of a Family Insane*).

	Pairs.	Cases.
Mother and daughter	157	314
Mother and son	96	192
Father and daughter	103	206
Father and son	78	156
Brothers and sisters	212	424
Two sisters	211	422
Two brothers	140	280
Husband and wife	69	138
Offspring and grandparents	24	48
Other relationships, collaterals, etc.	186	372
Total	1276	2552
142 instances of 3 of a family insane		426
24 „ 4 „ „		96
5 „ 5 „ „		25
2 „ 6 „ „		12
1 instance of 7 „ „		7
Total		3118

Total—3118 cases made up from 1450 families.

They show the following facts:

(1) In the insane offspring of insane parents daughters are much more numerous than sons.

(2) Amongst insane members of the same family (brothers and sisters) sisters are more numerous than brothers.

This fact may be correlated with the fact that more women are in asylums than men. About one-half of the people in the London asylums at the present time have, according to an admirably lucid report of the Clerk to the Asylums Committee, been resident more than ten years. The silting up in the London asylums at the rate of 125 to 200 per annum is largely due to women. There are several reasons for this: general paralysis, which is a fatal disease, is three times more frequent in men than in women; the recoveries in women do not bear the same proportion as in men. Now, why should women be

more liable to become insane than men? I will briefly summarise the causes which, in my opinion, are operative:—

The physiological emergencies connected with reproduction —*i.e.*, the menstrual periods, child-bearing, and the cessation of the period of reproduction, the climacterium; moreover, there is a more unstable mental equilibrium in women. I would also add as an important, and perhaps the only *cause* in many instances—the enforced suppression by modern social conditions of the reproductive functions and the maternal instincts in women of an emotional temperament and mental instability.

Anticipation or Antedating.

Dr. Maudsley has observed that Nature tends to mend or end a degenerate stock. Now, how could Nature best end or mend a degenerate stock? By segregating in a relatively few germs all the unsound elements, leaving the others free—as it were, a crystallisation out of the diseased elements. What would this do? you may ask. Well, it would make some of the offspring so weak by intensifying the disease and bringing it on at an earlier age that they would, if left to Nature's process of elimination, be killed off early, or unfitted for propagation by being brought into the asylums in adolescence. This was termed by Darwin "antedating" or "anticipation," and I have found that there is a signal tendency in the insane offspring of insane parents for the insanity to occur at an earlier age and in a more intense form in a large proportion of cases; for the form of insanity is usually either congenital imbecility or the primary dementia of adolescence, which generally is an incurable disease. This is statistically shown in the figures regarding the age at the time of first attack in the insane offspring of insane parents. You will observe that nearly 50 *per cent.* of these insane offspring had their first attack of insanity at or before the age of twenty-five, and whereas in the case of the insane parents advancing age apparently brings greater liability to insanity, in the case of offspring, with advancing age the liability to insanity tends rapidly to diminish. Now, besides the fact that this shows Nature's method of eliminating unsound elements of a stock, it has another important bearing, for it shows that after the age of twenty-five there is a greatly decreas-

ing liability of the offspring of insane parents to become insane, and therefore on the question of advising marriage of the offspring of an insane parent this is of great importance. Sir George Savage recently said in his presidential address that this statistical proof of mine accorded with his own experience, and that if an individual who had such an hereditary taint had passed the age of twenty-five, and never previously shown any signs, he would probably be free, and he would offer no objection to marriage.

Pedigrees and statistical data relating to antedating appear to show an intensification and anticipation by a coalescence or crystallisation out of the unsound germinal determinants into a few of the offspring, leaving the germ-plasm of the others free. This would not only purify the stock by segregation, but the diseased offspring would be unfit for the struggle for existence and propagation. In putting forward this theory of coalescence of similar diseased germinal determinants, I may mention in support of it a statement made by Galton in his great work on natural inheritance: "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."

Statistical Data relating to Inheritance and Insanity, especially in Relation to Anticipation.

From an investigation of the age at the time of first attack in 508 pairs of parent and offspring (from the records of 464 insane parents of 500 insane offspring) the following table has been compiled. The figures denote the percentage of cases whose first attack occurred within the given age-periods.

Age-periods.	Father.	Offspring.	Mother.	Offspring.	
Under 20 years	1·4	26·2	0·6	27·8	
20–24 years	0·4	18·0	3·4	15·7	Adolescence.
25–29 „	1·4	18·0	4·4	18·2	Adolescence.
30–34 „	9·6	13·0	7·8	13·4	
35–39 „	11·5	7·3	9·2	10·0	
40–44 „	9·2	6·4	10·3	5·8	
45–49 „	14·3	6·0	12·0	3·7	Involutional period.
50–54 „	17·5	0·9	12·3	2·4	Involutional period.
55–59 „	13·8	3·7	14·0	1·7	
60–64 „	10·1	—	11·6	1·3	
65–69 „	5·0	—	8·8	—	
70–74 „	4·6	0·4	3·1	—	
75–79 „	0·4	—	1·3	—	
80	0·4	—	0·6	—	

These figures are shown graphically in the following diagrams (Fig. 3), the abscissæ representing the age-periods and the ordinates the percentage of cases whose age at the time of first attack falls within the given periods. They clearly show the signal tendency to the occurrence of most of the insanity in the offspring of insane parents at a much earlier age than in the parent; that is to say, antedating or anticipation is the rule.

Investigating the ages at the time of first attack in the insane offspring of insane parents, I find in the following pairs that

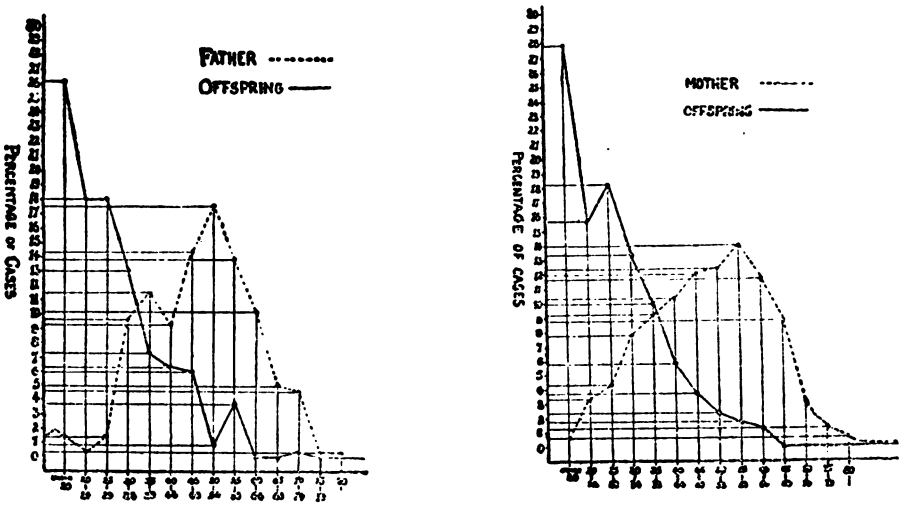

FIG. 3.—A comparison of these two curves shows a notable difference in the dotted line curves of the two parents. The curve of the mothers rises steadily and progressively from 20–55. The curve of the fathers does not commence to rise till after 25; there is a small peak at 35–39. This is the period when general paralysis is most likely to occur. But the main difference in the curves of fathers and mothers is due to the incidence of child-bearing, which causes the steady rise to the climacterium in the maternal curve.

239, or 47·8 *per cent.* out of 500 offspring had their first attack at or before the age of 25 :—

Mother—son	.	.	51 out of 118 offspring.
Mother—daughter	.	.	81 „ 170 „
Father—son	.	.	45 „ 90 „
Father—daughter	.	.	62 „ 122 „
Total	.	239 out of 500 offspring = 47·8 *per cent.*	

The following table shows the average age at the time of first attack in the parent and offspring :

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	Parent.	Offspring.
120 pairs mother—daughter	49·7	29·3
67 „ mother—son	50·2	30·7
76 „ father—daughter	50·1	30·4
51 „ father—son	51·9	33·1
79 parents, 133 offspring in families with more than two insane	47·7	28·7
Total, 393 parents, 427 offspring	49·7	30·0

In addition there were 71 parents whose average age was 49 at the time of the first attack who were associated with imbecile offspring.

Lastly, I find that in 299, or 58·8 *per cent.*, of the 508 pairs of insane parent and offspring, the first attack in the offspring occured at an age twenty or more years earlier than in the parent; of these 299 instances 73 of the offspring were imbeciles.

Collateral Heredity.

When collateral heredity is studied the same signal tendency to occurrence of anticipation or antedating is shown, as the following tables and curves prove.

The subjoined table is compiled from 193 pairs of uncles and aunts with nieces and nephews in which only collateral heredity is manifested, and 231 pairs of uncles and aunts with nieces or nephews, in which are included those instances where one or both parents of the nieces and nephews are also insane. The figures denote the percentage of cases whose first attack occurred within the given age-periods.

Age-periods.	Collateral only.		Collateral and direct.		
	Uncle or aunt.	Niece or nephew.	Uncle or aunt.	Niece or nephew.	
Under 20 years	5·2	20·7	5·2	25·5	
20–24 years	3·1	19·2	3·4	17·7	Adolescence.
25–29 „	6·2	18·6	7·8	19·0	
30–34 „	12·9	17·1	14·3	15·1	
35–39 „	11·9	12·4	12·1	11·2	
40–44 „	11·3	5·7	10·4	4·3	
45–49 „	12·4	2·1	12·1	2·6	Involutional period.
50–54 „	14·5	2·1	12·1	1·7	
55–59 „	7·7	1·5	8·6	2·1	
60–64 „	8·8	—	8·2	—	
65–69 „	1·5	0·5	1·7	0·4	
70–74 „	1·0	—	1·3	—	
75–79 „	3·1	—	2·6	—	
80 „	—	—	—	—	

These figures are shown graphically in the following diagrams, the abscissæ representing the age-periods and the ordinates the percentage of cases whose age at the time of first attack falls within the given periods (Fig. 4).

Of the insane nieces and nephews of insane uncles and aunts, 103 out of 208, or 49·5 *per cent.*, had their first attack at or before the age of twenty-five:

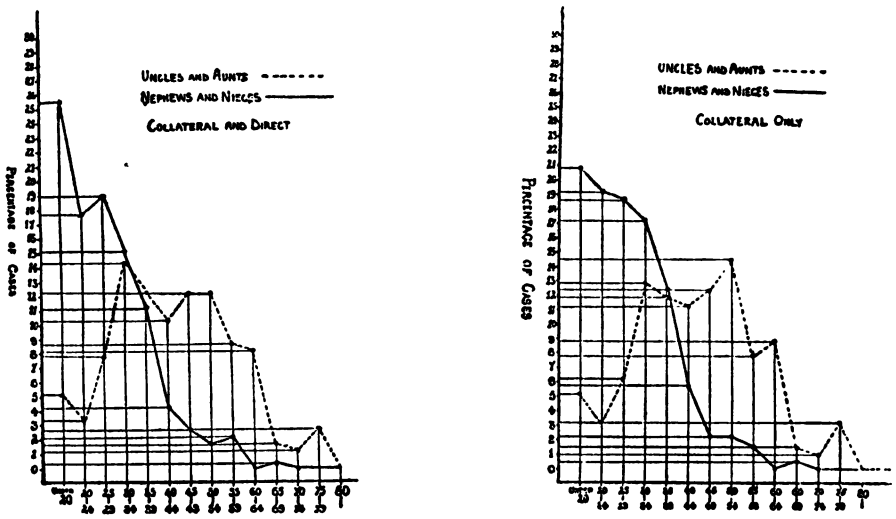

FIG. 4.—A comparison of these two curves shows that the tendency to anticipation or antedating is less marked when there is only collateral inheritance; it will be observed that the offspring curve slopes very gradually in comparison with that of parent and offspring, as well as with that of collateral and direct.

Uncle—nephew or niece	.	51 out of 93	
Aunt—nephew or niece	.	52 „ 115	
Total	.	103 „ 208	= 49·5 *per cent.*

Study of the Neuropathic Inheritance by Pedigrees.

I have already published in my presidential address to the Neurological Section some pedigrees illustrating the points of my argument regarding anticipation (1), but I propose to show a few of these and other new ones; moreover, Dr. Hill Wilson White will later refer to twenty-four pedigrees which he has most carefully investigated.

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Some Family Records showing Anticipation.

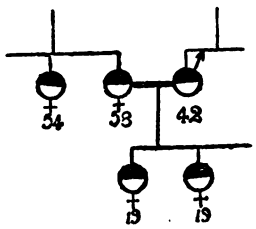

FIG. 5.

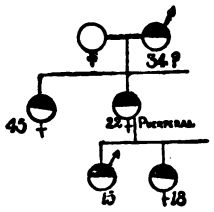

FIG. 6.

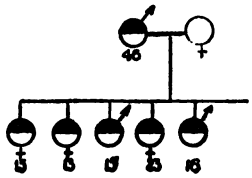

FIG. 7.

FIGS. 5, 6 and 7.—Three pedigrees to illustrate "antedating"; the onset of insanity in the offspring is shown to occur at a much earlier age than in the parents. These pedigrees also illustrate extreme cases of hereditary transmission of the neuropathic taint; as a rule, not more than one insane offspring of an insane parent occurs in four or five. The occurrence of insanity in all the children is probably due to the fact that there is a double insane inheritance in all these instances, although it is only shown in one completely, and one partially.

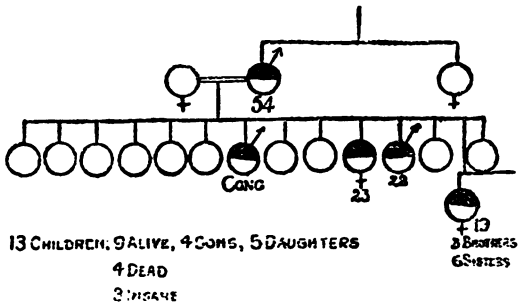

FIG. 8.—A. B—, an alien Jew, æt. 54, was admitted to an asylum for the first time, suffering with involutional melancholia; he has a sister who has not been in an asylum, but, as events turned out, bore the latent seeds of insanity. The man is married to a healthy woman, who bore him a large family; the first six are quite healthy, then comes a congenital imbecile epileptic (cong.), then two healthy children, followed by a daughter who became insane at age of 23, then a son insane at age of 22, and lastly, two children who are up to the present free from any taint. The sister of A. B— is married, and has a family of ten—seven girls and three boys; one of the females was admitted to the asylum at the age of 19, and since this pedigree was constructed a brother of hers has been admitted, aged 24. Half-black circles are insane. This pedigree is instructive: it shows direct and collateral heredity; it also shows remarkably well the signal tendency to the occurrence of insanity at an early age in the children of an insane and potentially insane parent.

Professor Karl Pearson, writing to *Nature*, November 21st, 1912, "On an Apparent Fallacy in the Statistical Treatment of 'Antedating' in the Inheritance of Pathological Conditions,"

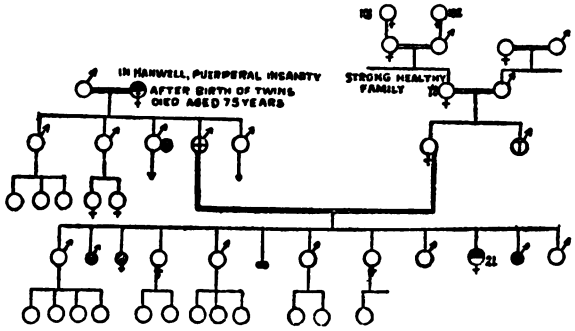

FIG. 9.—In the above pedigree is shown the mating of a female descendant of a strong healthy family with longevity to the drunken son of a drunken mother, who also had an attack of puerperal insanity. Of the children from this marriage three died young; *the one affected member became insane in adolescence and has died of tuberculosis in the asylum* (half-black circle), whilst the remainder are apparently healthy, and those who are married have healthy children.

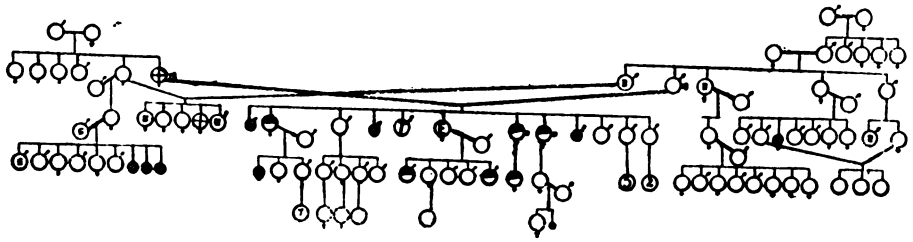

FIG. 10.—This pedigree is of interest in showing the marriage of two brothers with two sisters. In the first instance the male suffered with heart affection, which was transmitted to the offspring. In the second case the female suffered from cirrhosis of the liver and paraplegia, and was probably alcoholic and possibly syphilitic. The result was three insane and one epileptic offspring. From the first insane daughter the issue was apparently unaffected; but from the next daughter, who had masked epilepsy, of five children born two were insane. The next two insane daughters each gave birth to an illegitimate child by the same father; one of these children became insane at adolescence, whereas the other has married and has an apparently healthy child. H denotes heart affection. Half-black circles, insanity.

criticises on mathematical grounds the evidence of anticipation. I do not feel myself competent to reply to the opinion of such an eminent authority on mathematics applied to biometrics, but it does not militate against my conclusions, nor explain

away the fact that a large proportion of the insane offspring of insane parents are affected with imbecility or adolescent insanity; for granting the assumption that there is no antedating at all, we might rightly expect the ages at onset of the insane offspring of insane parents to be comparable with

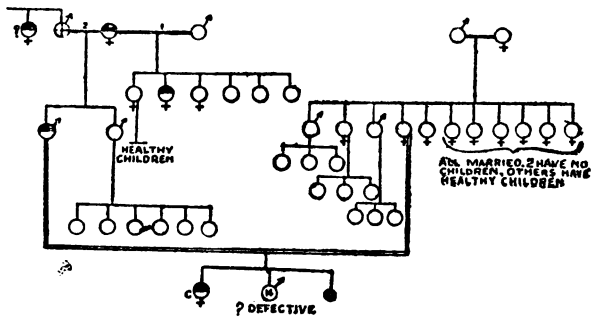

FIG. 11.—This pedigree commences with an insane woman who first marries an apparently healthy man, and of their six children one becomes insane. She next marries a drunkard whose sister is reported to be insane. The result of this marriage was a weak-minded son, who came into the asylum at the age of 42, and an apparently normal son, who marries and has healthy children. The insane son married a woman coming from a good stock, with the result that their first-born daughter is an imbecile, and the second born, a son, is mentally defective.

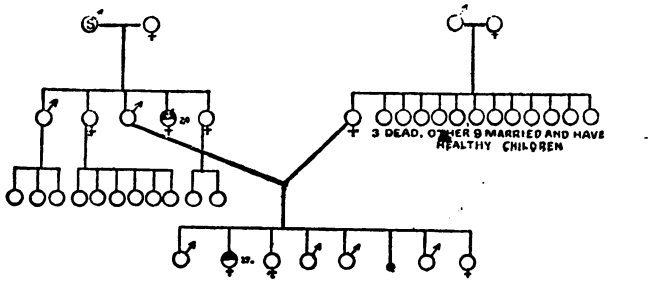

FIG. 12.—This pedigree shows the hereditary taint, commencing with suicide (s) in the grandfather and insanity in the next two generations; in each generation the affected member was cut off by adolescent insanity.

the ages at onset of all the admissions to the asylums during the same period. This is by no means the case, for amongst the insane offspring there is a far greater proportion affected in early life.

I may say that the examination of pedigrees first led me to regard antedating as Nature's method for eliminating the unfit,

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and the pedigrees, which are numerous, that I have since obtained all strengthen the opinion. I hope shortly to publish a large number of these pedigrees and further elaborated statistics on the question of antedating, obtained from a further collection of data since the above figures were obtained.

Professor Pearson in one way does not deny the fact that there is a tendency for an insane stock to be either ended or mended, which is really an important practical point we have to decide, for he says: "In the case of insanity is the man or woman who develops insanity at an early age as likely to become a parent as one who develops it at a later age? I

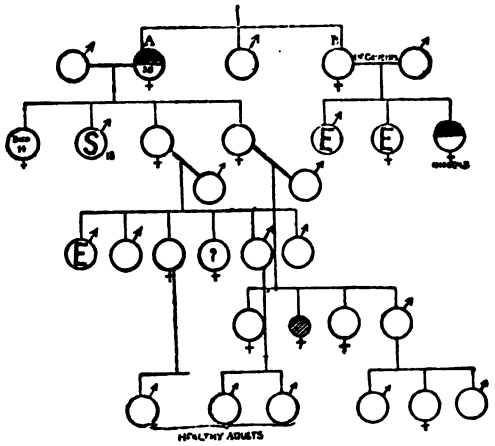

FIG. 13.—This pedigree shows the result of marriage of first cousins, in both of whom there was a latent neuropathic taint. The family consisted of three individuals—two sisters, A and B, and an elder brother, who was married but had no family. B married a first cousin, and although neither of them were 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.

think there is not a doubt as to the answer to be given; those who become insane before the age of twenty-five, even if they recover, are far less likely to become parents than those who become insane at later ages: many, indeed, of them, con-

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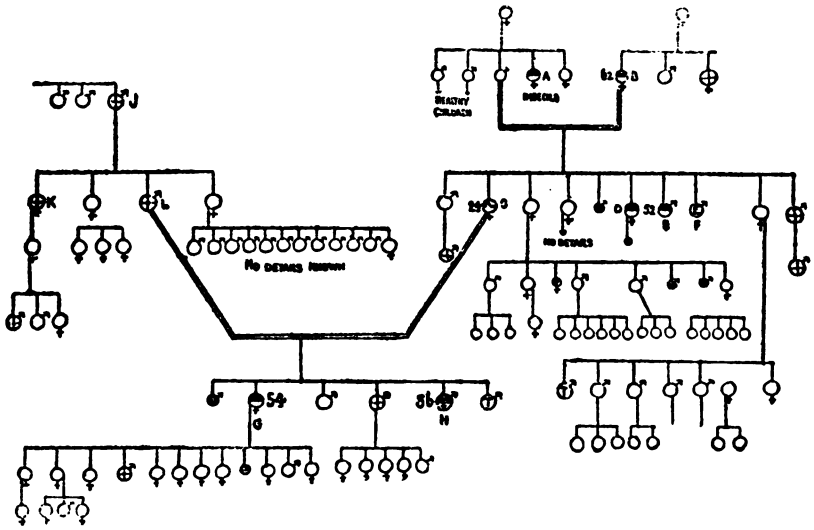

FIG. 14.—Pedigree showing the apparent elimination of the unsound elements in a stock with dual insane inheritance. A, an imbecile, but was never put away. B became insane at the age of 62; melancholia; in Colney Hatch Asylum for nine months, but eventually died in Caterham Asylum. C became insane at the age of 24 (St. Luke's Asylum) after the birth of her first child, which died in infancy; she was discharged after five months; her next attack occurred at the age of 38 (when suckling her last child), when she was in Hanwell for twenty months with acute mania; at the age of 43 she was admitted to Colney Hatch and died there seventeen months later. D, very peculiar and eccentric, but was never put away; she married twice, and by her first husband had one child which died in infancy from convulsions, by her second husband no children; she died between 40 and 50 years; described by her relatives as insane. E became insane at the age of 52, acute mania, and died after three days' residence in Hanwell; had been in feeble health for years and had suffered from lead colic on two occasions. F, epileptic fits from infancy; admitted to Hanwell Asylum at the age of 28; after seventeen years' residence was transferred to Glamorgan County Asylum. G became insane at the climacteric period; admitted to Cane Hill at the age of 54; chronic mania; teetotaler; her children and grandchildren, with the exception of one son, aged 26, who "drinks and bets," are not affected. H has had delirium tremens; married an alcoholic, now in Islington Infirmary; no children; first certified at the age of 36 and has been in and out of asylums ever since; has been in Claybury Asylum five times, and other asylums besides; in features he is supposed to resemble his paternal grandfather, but in versatility and humour apparently resembles his maternal grandfather, who was a famous clown. J, K, L are reported to be alcoholic, but in spite of this they all lived to good ages. J died at the age of 78; K is still living, over 70 years of age; and L died at the age of 74. Longevity is a characteristic of this stock.

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sidering the high death-rate of the insane, will die before they could become parents of families."

Mr. Nettleship has shown that antedating occurs in other diseases, notably diabetes, and it was he who called my attention to the probability of my being able to show antedating and insanity, because I remarked that I seldom found insanity

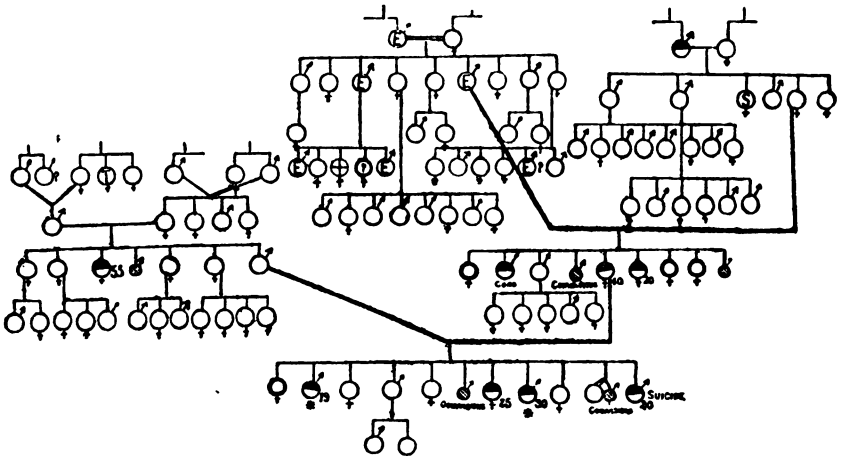

FIG. 15.—A very comprehensive and interesting pedigree obtained for me by Dr. Wilson White, showing the result of marriage of a nearly sound stock in which the temperament was, generally speaking, of the sanguine type; there was only one member insane at fifty-five, she was unmarried; her four sisters, who were all married, had some healthy, grown-up children. The brother himself, perfectly sane and healthy, married a woman descended from stocks in one of which there were many members suffering with epilepsy (E); indeed, her father and her grandfather suffered with it. On the maternal side there was suicide (S) of an aunt and insanity of a grandfather: most of the members of this stock were of a melancholy, brooding temperament. The result of the mating of these two neuropathic stocks is shown. There were nine children—of which three, marked with deep black-rimmed circles, suffered from some form of neurosis; a male congenital imbecile; a healthy male who has five healthy children; a child who died in early life of convulsions; the patient's mother, who became insane at the age of forty; a female who became insane at the age of twenty; two females also suffered with some form of neurosis; lastly, a male who died in early infancy. The next generation shows the result of mating this unsound stock with an almost healthy, sound stock. There are not as many unsound members as in the last generation, and we observe that the four members that became insane at the ages of nineteen, twenty-five, thirty and twenty, all had their first attack at a much earlier age than their mother: one of these committed suicide and two were found dead. This pedigree illustrates well the signal tendency to the occurrence of antedating. The sound members of the stock apparently inherited their temperament from the father's side, and the one member that married has quite healthy children; this looks as if the unsound elements of this degenerate stock had been cleared out by segregation of the unsound germinal determinants, causing intensification of the disease and occurrence of the onset at an early age, thus preventing propagation.

occurring in pedigrees beyond three generations; there was a tendency to elimination of the unsound members by early death.

Erasmus Darwin, the grandfather of Charles Darwin and Francis Galton, said: "As many families become gradually extinct by consumption, epilepsy, mania, it is often hazardous to marry an heiress, as she is often the last of a diseased family." In a letter to the father of Charles Darwin, probably prompted

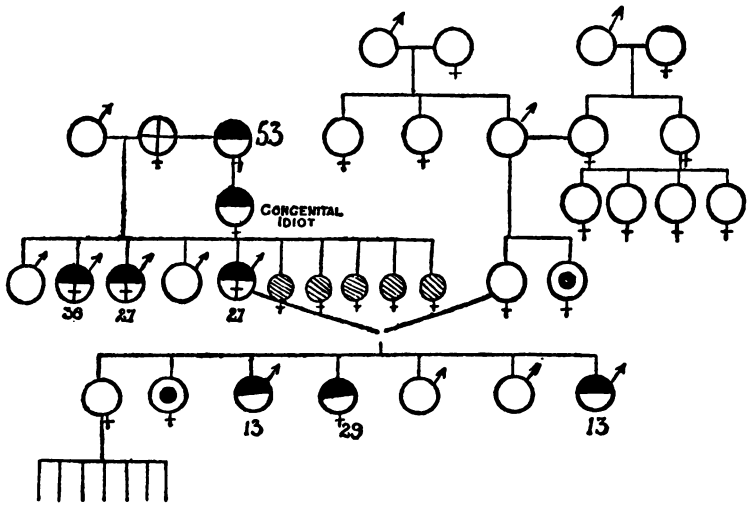

FIG. 16.—A family of drunken and insane people. The figures with half-black circles are insane; the same with the cross indicate drink and insanity; the circles with only a cross indicate excessive drinking. The two stocks show a marked difference; one side, the maternal, is practically free from any taint; almost every member of the paternal stock is unsound. The degeneracy commenced with a drunken woman, whose sister died, aged fifty-three, in Colney Hatch Asylum, where she had been twenty years; she had a congenital imbecile daughter in Leavesden. The result of mating a sound individual with a drunken woman with insane predisposition is shown in the members of the family born: a son healthy, then two alcoholic sons who were insane at the ages of thirty-six and twenty-seven, then a healthy son, then another alcoholic son, who also was insane at the age of twenty-seven; finally, five daughters who died in early life, probably through the neglect of a drunken mother, indicated by small, shaded, circular figures. One member of this drunken and insane family married into a healthy sound stock. Seven children were the fruit of this marriage; of these, two sons and a daughter were normal, and three were insane, two of them having become insane at the age of thirteen. The clear circle with a black centre indicates bodily disease. I used to give this pedigree as an instance of drink causing insanity, but after the establishment of the card system of relatives I found the notes of the sister of the drunken grandmother; she was an inmate of Colney Hatch for twenty years. It sometimes happens that the one is taken and the other left, and it would have been a benefit to society if the drunken progenitor of this degenerate stock had been taken.

by the fact that one of his sons committed suicide, he wrote: "I know many families who had insanity on one side, and the children, now old people, have had no sign of it. If it were otherwise there would not be a family in the kingdom without epileptic, gouty, or insane people in it." Francis Galton, his other distinguished grandson by his second wife, established the law of filial regression, or the tendency to re-establish the normal average of the race. It is remarkable how this progenitor of our two greatest biologists anticipated the epoch-making discoveries of his most illustrious grandsons.

Our President has himself found in his large practice that there is a tendency for the offspring of insane parents to become insane at an earlier age, and in the question of marriage it is of signal importance.

I shall be glad to hear the experiences of other members of the Section on this point concerning heredity and insanity.

Single compared with Dual Neuropathic Inheritance.

Every pedigree is a study in itself, and occupies a whole book if systematically carried out as regards inheritance of characters, and the classification of the same is a matter of considerable difficulty. We have not enough systematic pedigrees yet to form precise data and conclusions upon, but I may be permitted to refer to indications from the examination of pedigrees of three generations which I have obtained myself, and combined with those obtained by Dr. Wilson White, Dr. Cribb, and Dr. Daniel. I will divide them into two groups: (1) Those with a double pathological inheritance—that is, both ancestral stocks show insanity, feeble-mindedness, drunkenness, epilepsy, suicide, or nervous disease of various kinds, direct or collateral within two generations; and (2) those with a pathological inheritance on one side only.

(1) The analysis of families with a double insane inheritance, represented by insanity, suicide, nervous disease, in both paternal and maternal antecedents, direct or collateral, within two generations:

Eighteen Families Examined.

Number of children.	Number died young.	Insane, suicide, nervous disease.	Apparently normal.
116	16	39	61

39 *per cent.* of the offspring reaching adult age were affected.

(2) The analysis of families in which there was an insane inheritance on one side only:—

Ninety Families Examined.

Number of children.	Number died young.	Insane, suicide, nervous disease.	Apparently normal.
384	40	33	311

9·6 *per cent.* of the offspring reaching adult age were affected.

The conclusion which may be drawn is that a child born of a dual neuropathic inheritance stands on an average a chance of being insane four times as great as where only one stock is infected. This, however, applies to the general average, and not to individual cases.

Propagation of the Insane in relation to Hereditary Transmission.

As a leading article in the *British Medical Journal* of May 11th, 1912, refers to this question of my investigations upon anticipation tending to the ending or mending of a degenerate stock being used as an argument against measures being taken to prevent the propagation of the unfit, I particularly desire to impress upon my audience the fact that I have always laid a great stress upon the necessity of *segregating congenital imbeciles* now that Nature by man's aid does not kill them off as formerly. Moreover, it is highly desirable to follow up those members of the family who are sane, and particularly those who are discharged as cured, in order to see whether Nature has really mended that particular degenerate stock.

One of the great arguments advanced for sterilisation has been that recurrent cases of insanity breed lunatics in the intervals of readmissions to the asylums. I have no doubt this is the case. But before Parliament would even consider such a procedure justifiable it would require the strongest and soundest evidence that life segregation or sterilisation would appreciably diminish the numbers of the insane. Single instances are attractive as copy for newspapers, and may serve as object-lessons to the public, but the Legislature will require comprehensive data and statistics. In the following table are some preliminary data relating to this question.

The following figures represent an analysis of the female admissions to three asylums during the year 1911:

Hanwell	.	164 female admissions	.	32 recurrent cases.		
Claybury	.	259 „ „	.	64	„	„
Cane Hill	.	219 „ „	.	52	„	„
Total	.	642 „ „	.	148	„	„

Further investigating these recurrent cases, the following figures are obtained:

	Hanwell.	Claybury.	Cane Hill.
Single	10	23	21
Married, but no children born during lucid intervals. Involutional insanities, etc.	10	25	13
Married, children born during lucid intervals	10	10	12
No history obtainable	2	6	6
Total	32	64	52

Of 642 female admissions, 148 were recurrent cases, of whom thirty-two (21 *per cent.*) had children between their respective dates of admission. Dr. Spark has forwarded me a list of thirty-three cases (18 *per cent.*) from a total of 185 recurrent female cases examined who had also given birth to children during their lucid intervals.

The inference that can be drawn is that about one-fifth of the recurrent cases, or approximately one-twentieth of the female admissions, have children after their first attack of insanity, and of thirty-one such cases examined, seventy-three children were born after the first attack of insanity in the parent. A number of these cases were puerperal insanity. I am unable to give the exact figures as to the fate of these children, but a good proportion of them died in infancy, and the majority of them would be too young for us to decide which might become insane.

Recurrent insanity and epilepsy, with which it is closely allied, in relation to hereditary transmission, offer one of the most important problems for scientific investigation by complete family histories and construction of pedigrees, and I can conceive no more important work on the relation of heredity to insanity than the following up systematically of the history of children born in the sane intervals of cases admitted several times to the asylums.

From the statistics of relatives a computation has been made of the proportion of offspring who were born after the first

attack of insanity in the parent. The figures are as follows: 590 pairs of parent and offspring investigated from 529 insane parents with 581 insane offspring.

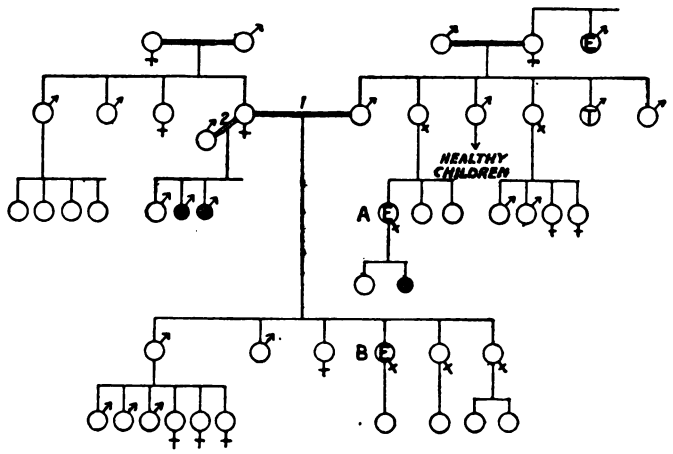

FIG. 17.—This pedigree is of interest in showing the appearance of epilepsy in two members of a stock after it had missed a generation. All other members of the stock were mentally unaffected. One of the offspring of one of the affected members (A) died from injuries received while the mother was in a fit; while the only child of the other affected member (B) was the result of seduction by her stepfather.

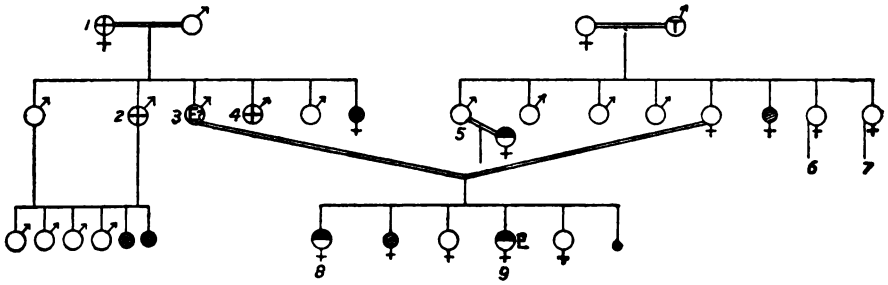

FIG. 18.—The above pedigree shows the intensification of the neuropathic taint in a stock with the elimination of the two affected members by adolescent insanity. No. 1, the grandmother, was alcoholic, and died at the age of 40. Of her children, Nos. 2, 3, and 4 were alcoholic, excitable, and violent. No. 3 "had stupors like No. 9," and eventually died from tuberculosis at the age of 36. His wife came from a comparatively good stock, as shown by the fact that Nos. 5, 6, and 7 have healthy children and grandchildren, in spite of the fact that the wife of No. 5, about twenty years ago, was a resident of Banstead Asylum for a period. Of the children of No. 3, No. 8, a girl, was certified at the age of 16, and died in Claybury Asylum from tuberculosis at the age of 21. No. 9, her sister, was subject to fits, and was admitted to Claybury Asylum at the age of 21, where she is still resident. The other two sisters are exceedingly nervous and emotional.

Mother and daughter, pairs	. .	17 children born after first attack.	
Mother and son	,, . .	9	,, ,,
Father and daugher	,, . .	11	,, '
Father and son	,, . .	9	,, ,,
Total	. . .	46	,, ,,

Forty-six offspring out of 581 were born after the first attack of insanity in the parent—*i.e.*, 7·9 *per cent.*

That is to say, in the case of 529 insane parents *the birth of only one-twelfth of their* 581 *insane children would have been prevented*

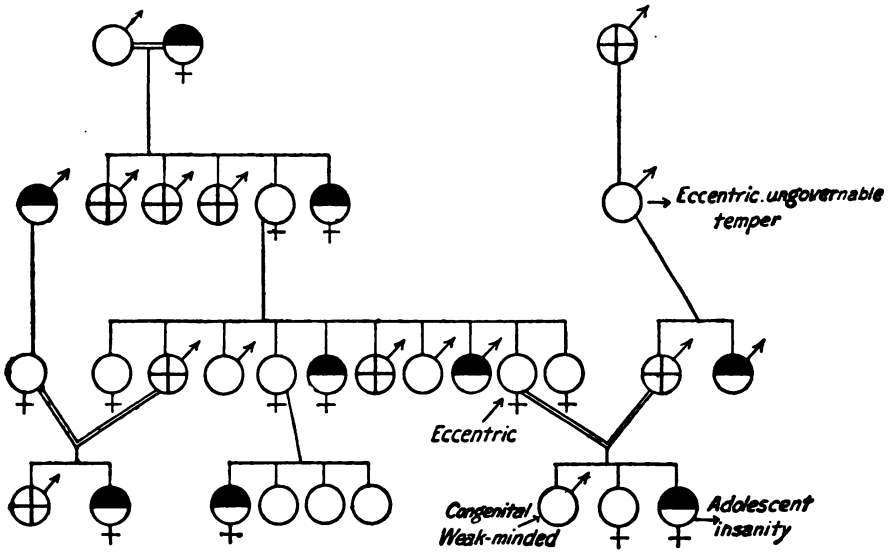

FIG. 19.—Pedigree of a well-to-do family with marked alcoholism (circles in quadrants) and insanity (half-black circles).

by sterilisation or life segregation of the parent after the first attack of insanity.

These figures refer to the offspring which become insane, *but there are a large number of offspring which do not become insane, and these would be cut off if life segregation or sterilisation were adopted.*

STATISTICS OF GENERAL PARALYSIS IN RELATIVES.

The incidence of general paralysis in families where *two* members have been in the London County asylums is as follows:

Mother and son.—96 families: 8 families in which general paralysis figured—in 1 the mother was affected, in 7 the son was affected, and in none were both affected.

Mother and daughter.—157 families: 3 families in which general paralysis figured—in 1 the mother was affected, in 1 the daughter was affected, and in 1 both were affected.

Father and son.—78 families: 13 families in which general paralysis figured—in 5 the father was affected, in 8 the son was affected, and in none were both affected.

Father and daughter.—103 families: 12 families in which general paralysis figured—in 10 the father was affected, in 1 the daughter was affected, and in 1 both were affected.

Brothers.—140 families: 32 families in which general paralysis figured—in 26 one brother only was affected, and in 6 both were affected.

Sisters.—211 families: 8 families in which general paralysis figured—none in which both were affected.

Brother and sister.—212 families: 18 families in which general paralysis figured—in 17 the brother was affected and in 1 the sister was affected.

Grandparent and offspring.—24 families: 1 family in which the grandparent was a general paralytic.

Collateral pairs.—186 families: 24 families in which general paralysis figured—in 2 families both male cousins were affected, in 2 families both uncle and nephew were affected, in 5 families one male cousin was affected, in 3 families the aunt alone was affected, in 6 families the uncle alone was affected, in 5 families the nephew alone was affected, in 1 family the niece alone was affected. As general paralysis is fatal within a year or two of admission, difficulties arise in regard to pairs of paralytics being known, unless one of the pair has been resident since the card system was initiated. Thus, to my knowledge, during the last fifteen years there have been three or four cases of husband and wife and several of father and son.

The Neuropathic Inheritance in relation to General Paralysis.

It is generally admitted that in the pedigrees of general paralysis of the insane, the "neuropathic taint" is not found to anything like the extent that it is in the pedigrees of patients suffering from neuroses, psychoses and feeble-mindedness. This is not surprising if we regard general paralysis as an organic disease due, like tabes, to the action of the syphilitic organism.

Our President, in his Lumleian Lectures,(*) emphasised this

https://doi.org/10.1192/bjp.59.245.222 Published online by Cambridge University Press

fact that general paralysis is not associated with an hereditary taint to anything like the extent that other forms of insanity are. I have endeavoured to investigate this question by comparative statistics of the incidence of general paralysis occurring in the 3,118 relatives who have been admitted to the London County asylums, and the incidence in the admissions of the total population; also by comparison of deaths from general paralysis among these two classes of individuals, and I think my results bear out the premise that the neuropathic taint does not enter as a large factor in general paralysis. I will summarise my researches on this subject as shown in the subjoined tables.

Table I.

Incidence of General Paralysis amongst Residents in Asylum Population. 1911 Report, Table E2.

	Males.	Females.	Male and female.
Total population	8,591	11,475	20,066
General paralytics	334	128	462
Percentage	3·9	1·1	2·3

Incidence of General Paralysis amongst Resident Related Cases.

Total related cases	616	892	1,508
General paralytics	16	7	23
Percentage	2·6	0·8	1·5

The above Table I shows that whereas in the total resident population of the London County asylums the proportion of female general paralysis patients to male general paralysis patients is 1·1 *per cent.* to 3·9 *per cent.*, among the resident population of relative cases numbering 1,508 it is 0·8 *per cent.* females to 2·6 *per cent.* males; there are therefore considerably fewer males and females *pro rata* among the relatives resident.

Table II.

Incidence of General Paralysis amongst Total Deaths occurring in the London County Asylums during the last Five Years.

	Males.	Females.	Males and Females.
Total deaths	4,126	3,980	8,106
General paralytics	1,385	349	1,734
Percentage	33·5	4·2	21·3

Incidence of General Paralysis amongst Related Cases that have Died.

Total deaths	370	379	749
General paralytics	142	16	158
Percentage	38·3	8·7	21·1

https://doi.org/10.1192/bjp.59.245.222 Published online by Cambridge University Press

The above Table II shows that if we compare the number of deaths from general paralysis during the last five years in all the London County asylums we find 21·3 *per cent.* of the total deaths were in general paralytics. Our relative cards refer to 749 deaths, and of these, as Table II shows, there were 158 cases of general paralysis, a total death-rate of 21·1 *per cent.* Again, comparing the deaths from general paralysis in 2,000 *post-mortem* examinations at Claybury, I found 23·0 *per cent.* of the total died from general paralysis; the slight increase no doubt was due to diagnostic error during life.

You will no doubt be struck by the relatively fewer females and the larger number of males *pro rata* among the relatives compared with those of the total population. There is half the percentage of females, and 4 *per cent.* more males, although the total incidence is almost identically the same (21 *per cent.*). I would explain this as due to two causes:—

(1) The relatively fewer general paralytic cases occurring among the relatives is probably due to the fact that a considerable number of women admitted to the asylums suffering with general paralysis are derived from a class of female who is more likely to have suffered with syphilis than any other; they are euphemistically described as of no occupation. The prostitute either has no friends to visit her or she is disowned by her relatives, and therefore she is far less likely to appear in the relative cards.

The difference among the males is not so great, and may be of no consequence, or the slight increased incidence of general paralysis among the relative cases may indicate that the neuropathic taint does play a small part in the production of general paralysis amongst these cases. The slight increase may also be due to the comparatively large number of brothers affected.

I found 18·7 *per cent.* of pairs of brothers affected with general paralysis of the insane. Now it may be asked, Why should there be relatively such a high percentage of brothers affected, if the neuropathic tendency did not play an important part in the production of general paralysis? Its explanation is possible in three other ways.

Sir George Savage has always maintained the important influence of sexual excess; indeed, in his text-book he speaks of the general paralytic wife. I am of opinion that the ardent sexual temperament has much to do with the production of

both tabes and general paralysis. A temperament is even more likely to be inherited than the "neuropathic taint." If we admit, as we must, the possibility of the existence of such a temperament in two brothers, then we can explain the frequency of the incidence by a temperamental inheritance favouring the onset of general paralysis. But it is possible that two brothers might get syphilis from the same source; there is evidence indicating that there may be a specific virus for these parasyphilitic affections. Lastly, I would suggest as a cause of this greater liability of brothers to general paralysis the possibility of an inherited immunity hypersensibility to react to the specific organism of syphilis. In favour of this argument I advance the following premises:

The great majority of cases of general paralysis suffer with very mild primary and secondary symptoms; tertiary signs in the form of gummata are rarely met with, and I base this statement upon the *post-mortem* examination of over 500 general paralytics. The average time after infection is ten years, and it matters not whether the patient has been treated with mercury or not. Specific remedies, arsenic as well as mercury, have no curative effects. The Wassermann reaction is very pronounced in both the blood and the cerebro-spinal fluid, which I regard as possibly evidence of an increased immunity hypersensibility. An excitable, neurotic man who is also erotic is more liable, if he has this immunity hypersensibility, to suffer from a premature primary decay of his nervous system, ending in tabes or general paralysis.

The Creation of the Neuropathic Inheritance.

If Nature is always trying to end or mend degenerate stocks, what is the reservoir from which fresh degeneracy arises? Can a sound stock be made degenerate by prolonged toxic conditions of the blood? In fact, can two germ-plasms which have been long subjected to poisoned conditions of the blood undergo a pathological mutation affecting only the functions of that most complex and delicate of all organs—the brain. The poisons may be introduced into the body from without for long periods of time, as in the case of chronic alcoholism. The poison may be engendered in the body as the result of the growth of parasitic organisms—*e.g.*, syphilis and tuberculosis;

or it may be a result of disorder of the functions of one or more of the glands whose internal secretions are essential for vital activities; or glands like the liver and kidneys, which are essential for ridding the body of waste products, may fail in the performance of their functions. The blood-stream no longer under such conditions maintains its normal biochemical relation to the organs of the body; a vicious circle tends to occur in which even the specially protected structures may suffer. The brain itself may immediately or quite early feel the influence of the change in the blood, and the unpleasant symptoms aroused may thus be a protective warning to the intelligent mind, and efforts will be made to avoid the danger, if the sensibilities are not blunted by habit and tolerance. The germ-cells are undoubtedly protected against the influence of poisons, but they are nourished by the same blood and lymph as the body-cells; prolonged toxic conditions of the blood — *e.g.*, by syphilis, alcoholism, and tubercle, the racial poisons—cannot but affect their specific vital energy, one manifestation of which may be irritable nervous weakness.

Admit that irritable nervous weakness—neurasthenia—may be the starting-point of an unstable nervous condition in a previously healthy stock which in successive generations may intensify under a continuance of an unfavourable environment; and admit, as we must, that this unstable nervous condition is a special outcome of modern civilisation and does not exist in a primitive people living a simple mode of existence—then as fast as Nature eliminates unsound elements by ending or mending degenerate stocks, social conditions tending to neurasthenia, or nervous weakness as the term implies, may be produced by a vast number of combinations owning a social cause related to unphysiological modes of existence causing bodily and mental stress. Among the most important are prolonged poisoning of the body, including the specially protected structures, the brain and the germ-cells, by indulgence in excess of alcohol, syphilis, tubercle, lead and the drug habits; the nervous exhaustion caused by the poisons of infectious diseases, fever and bodily diseases, and the anxiety and mental pain associated therewith. The nervous exhaustion resulting from sexual excesses of all kinds, and from the mental pains arising from the ungratified natural desires of the sexual passion, from the stress of the city and town life with its feverish pursuit of gain

and pleasure, from competition, whether in examination, occupation or business, from the constantly increasing departure from physiological modes of life. The existence of more refined physical and mental enjoyments, bringing with them desires and emotions previously hardly known or realised; marriage without parentage and restriction of the birth of offspring, starving the maternal instinct, in which is rooted the highest altruistic feelings, developing the neurotic self-regarding temperament which so frequently precedes hysteria and insanity. Then prolonged emotional stress—*e.g.*, grief, especially the grief that "does not speak but whispers the o'er-fraught heart and bids it break"—and hatred which rankles in the breast; sudden and emotional shocks—*e.g.*, disappointment in love, loss of a dear one, and, too often among the poor, death of the bread-winner and breaking up of the home—are the exciting causes of a mental breakdown. All these depressing conditions acting on the mind produce an injurious reaction in the body, causing sleeplessness, loss of appetite, and failure of the digestive and assimilative processes. Restoration of nerve potential and the nutrition of the whole body may thus become impaired, and a vicious circle produced which by continuous expansion tends to disturb more and more the biochemical equilibrium of the body functions leading to the generation of chemical poisons in the body or to failure of the excretory organs to eliminate poisons which should be cast out of the body. This auto-intoxication reacts upon the sensitive and exhausted brain, causing further mental depression (melancholia), or by paralysing highest control, to uncontrollable agitation and excitement (mania). It is obvious, therefore, that sociological conditions play an important part in the production of insanity; moreover, it shows that certain occupations, or no occupation, may predispose to insanity.

Summary of Points which require Discussion and Further Application.

Anticipation in Relation to ending or mending a Degenerate Stock.

In my opinion I am justified in concluding that there is a signal tendency to the occurrence of insanity in the offspring of insane parents at a much earlier age. Therefore a large proportion of the parents have given birth to their insane offspring

before they themselves were insane. Another point, and a very important one, which requires further investigation is this: Does the anticipation which I have shown necessarily either end or mend a degenerate stock? About the proof of the former condition there is no difficulty, for if there are no offspring, or the offspring die in early life, the stock is ended. There is, however, much more difficulty in being sure of the mending of the stock, as there are several questions still unsolved. Nature certainly attempts to mend the degenerate stock by causing the insane offspring of insane parents to suffer with congenital imbecility or primary dementia of adolescence, and thus much is done towards getting rid of unsound members; for these insane offspring would be, or should be, kept in asylums until they die; thus they would never have an opportunity of procreating. What we really want to know is, what is the fate of all the offspring and of the next generation, both of those who are sane and of those who have had an attack of insanity and are discharged as recovered? Do they breed insane or degenerate children? Have the lines of neuropathic inheritance been only partially cut off by Nature? A great many facts show that a disease may be latent and reappear in a stock when the conditions of mating or environment are favourable. Therefore, we require a collection of pedigrees which will prove conclusively that the offspring who are free from the insane manifestations during adolescence will breed children who will not become insane. This seems possible from the law of ancestral inheritance and Mendelian segregation, but the proof of this must be given. Even if it can only be shown that there is a strong tendency to end or mend a degenerate stock by nature, we shall learn by a study of these pedigrees how we can materially assist Nature in her effort—*e.g.*, supposing it were shown that the discharged *recovered* cases bore the seeds of insanity concealed in their body by later on begetting epileptics and congenital feeble-minded (in its widest sense), or children who later become insane, a clear indication would be afforded that something should be done to prevent this propagation of the unfit.

Secondly.—We want to know what are the inborn characters of children born to parents who suffer with recurrent insanity. Are they more liable to become insane than the offspring of parents suffering with other forms of insanity? Again, what is the proportion of children born in the sane intervals after the

first attack, and has the attack of insanity in the parent any time-relation to the insanity which subsequently develops in the offspring?

Thirdly.—What types of insanity are especially liable to transmit an insane or neuropathic inheritance? Under what circumstances have epilepsy and anomalous forms of epilepsy a greater tendency to transmit a neuropathic taint? To ascertain this a number of pedigrees of patients require to be taken.

I am in hopes that many of the members of the Section from their knowledge and experience will criticise freely my conclusions, showing any fallacies that they think underlie them. I shall be quite as grateful for this as for support of my premises, as my object may be summed up in the words of Bacon in his *Advancement of Learning, Divine and Human*:—"First, therefore, in this as in all things that are practical, we ought to cast up our account, what is in our power and what not; for the one may be dealt with by way of *alteration*, and the other by way of *application*."

Discussion.

The President (Sir George Savage) said that Dr. Mott had laid before them a wealth of information. Many of the facts of this paper were confirmatory of his experience of nearly half a century. First, it was taught that all insanity was inherited; that insanity in a family affected every member of that family, so that any one of them was liable to become insane. Later, one's faith was shaken by meeting such conspicuous examples as Dr. Mott had pointed out, in which Nature re-asserted herself, and perfectly healthy families were produced. Cases came before him in which there were three or four insane members of a family, and then suddenly a branch of that insane stock produced nothing but healthy offspring. Such facts compelled him to hark back, but now he was more convinced than ever that there was an enormously potent influence, which should be called the neuropathic influence, but the nature of which was not yet fully known. The relationship of neuropathic inheritance to other disorders had already been mentioned by the author. And one of the first to notice this was Dr. Maudsley, who regarded it as an alternation of neuroses; when a man suffering from asthma might have this replaced by an attack of insanity, and with the onset of insanity the asthma would leave him. The same was sometimes found in the case of gout and insanity, and diabetes and insanity. That was true not only of the individual but of the family, so that while the forefathers might have suffered from diabetes, the offspring were affected with insanity; or insane parentage might produce diabetic or gouty children. He had also been, for a long time, struck with the occurrence of "anticipation," though to Dr. Mott must belong the adoption of the term in this connection. The fact that there might be healthy stock derived from insane stock, that there might be a breaking out of the disease, was so marked in his experience, that when his advice was sought as to whether "A" should be allowed to marry, though his aunt or uncle, or more still, if his father or mother were insane, he at once asked the question, "At what age did the relative break down?" His next question was, "How old is the individual?" If the person whom "A" wished to marry was not already related to his family by blood, he would not object, provided there were no previous neurosis in the persons themselves. He would be very guarded if there had been a nervous breakdown at any time, even though it was stated to have been of no importance. A point which had been brought out very strongly was this tendency to "breed out" the disease, and to revert to the normal of the race; but

at present one could not say which members should or would be saved, and which would be lost. It was not just to condemn every member of an insane family to celibate life, He would say cousins must not marry if there was any neurosis in either of them; but cousins *qua* cousins might marry with impunity; indeed, it had been pointed out by Coutts, in his *Consanguineous Marriages*, that the most beautiful offspring might have been the result of brothers and sisters mating. Mere consanguinity was not enough to condemn them; but if that were associated with some neurosis, then the projected marriage should be stopped, if possible. With regard to brothers suffering from general paralysis, many years ago both Sir Thomas Clouston and he had an experience of not only brothers but twins who were suffering from general paralysis. It was one of the events which made him feel that there was a neurotic tendency, though a very small one, as a factor in that disease. Some French authors had stated that with a neurotic inheritance syphilis tended to produce tabes, but that constitutional syphilis occurring in an individual without a neurotic inheritance tended to general paralysis. He did not think that could be substantiated. The question of the possibility of an acquired character being transmissible was often brought up. He believed he had seen a certain number of instances in which members of a perfectly healthy stock, from some accident or injury—or of course from general paralysis—had developed insanity, and the offspring had been insane too. Thus it looked as if an acquired instability had been transmitted.

Dr. Hill Wilson White demonstrated the book devised and used by himself at the asylums for ascertaining the pedigrees of patients, and described a number of instructive charts of families on the screen. He said he had gone through forty pedigrees in all, and twenty-five of them were very complete. The only selection he made was to choose patients with two living relatives, if possible, so as to get information on each side. The abnormality on the mother's side seemed to be greater than that on the father's side. In reference to this fact it should be noted that all the pedigrees were of female patients. With regard to the general conclusions, there were a comparatively small number of insane in the pedigrees. In most of the pedigrees which he worked out the law of anticipation was confirmed; the insanity either died out by the patient going into an asylum and not marrying, or, in many cases, the patient broke down congenitally. It had been said that from a tuberculous individual one was liable to get a tuberculous stock, but these inquiries did not bear that out. Another thing was that one could never tell, in any insane stock, where any individual would break down, nor even whether he would break down at all. All one could say was that if he did break down it would probably be at an earlier age than the parent or grandparent had broken down.

Dr. Robert Jones (Claybury) said he did not quite agree with the statistics. He considered that Dr. Mott did not make quite enough of the inheritance of the general paralytic. He (Dr. Jones) had as a patient the grandfather, the father, and son, suffering from general paralysis. Yet he considered that general paralysis might attack a parent and nothing be transmitted to the children. He gathered the latter was the President's view. He collected statistics in regard to 100 cases of general paralysis at Claybury—males—who had died, and about the diagnosis of which there could therefore be no doubt, for the *post-mortem* examination verified the diagnosis. That series brought out the idea which he had always entertained. In the 100 cases in which the family history was complete there was a history of paralysis—he did not say general paralysis—but often given by the patient's friends as "spinal paralysis." In two of those cases he knew the disease was general paralysis. In 28 *per cent.* of the 100 cases there was a history of some kind of paralysis. In addition there was a history of some member insane in a very large proportion—namely, in 38 *per cent.* In 18 *per cent.* there was a history of drink in the parents. In the ancestry, nine of the fathers and four of the mothers of the general paralysis cases were insane, twelve gave a history of epilepsy in the ancestors, and thirty-one gave a history of tuberculosis. It was against Dr. Mott's view, but he maintained strongly, from the experience he had had at Claybury, that tuberculosis often figured in the ancestry or in the collaterals of patients who came into the asylum. The point he wanted to lay stress upon was that general paralysis of the insane was engrafted on what had been termed the neurotic temperament or the neurasthenic temperament, yet,

if he might suggest it, no definition of this had been given by Dr. Mott. What was the cause of neurasthenia? There was not always a nervous history. He appreciated the President's remarks on the alternation of asthma and insanity, and Sir Thomas Clouston's reference to influenza and insanity, when the latter considered influenza to have been responsible for lowering the nerve power of one-third of Western Europe. The ductless glands were also responsible for many cases of neurasthenia. Not long ago he had the case of a young woman who had been to many nerve specialists and had been treated as a neurasthenic case; she had "rest" treatment several times, but eventually drifted to the asylum. She seemed to him very like a case of ordinary myxœdema, but there was a distinct thyroid palpable. Dr. Mott kindly saw the case also, and they agreed that it was a neurasthenic case with symptoms of myxœdema. She died, and a very careful examination after death revealed a complete disintegration of the glandular structure of the thyroid, which was shown to have been inactive. There were probably many cases in which the ductless glands were at fault—the supra-renal capsules, the pituitary body, the thyroid, the lymphatics, and possibly other glands of which little was yet known. Considering that syphilis was so common, and that not more than 4 *per cent.* developed general paralysis, it must be grafted on to some neurasthenic base before it was revealed as general paralysis. He maintained strongly, and was supported by the statistics he had quoted, that general paralysis of the insane was, from the heredity standpoint, related to the other varieties of insanity and could be transmitted to descendants, and it would be most interesting and instructive to know, from the pathological standpoint, what was the underlying physical factor of the inheritance of insanity. Another point was the following: There were so many cases of insanity at the ages of forty-two, forty-six, sometimes fifty-six and sixty-three, that it showed the impossibility of ending insanity by segregation or by castration, or by sterilisation. Certainly in many of the cases the children were born before the occurrence of the insanity.

Dr. CRICHTON MILLER pointed out that Mendel's law was only intended to apply to unit factors in the first place. Insanity was, as Dr. Hyslop pointed out, a clinical entity. We were bound to be disappointed if we expected this law to hold in tracing the heredity of cases of insanity. Again, with regard to Galton's law, what Galton really pointed out was the *potential* contribution of each ancestor, rather than the actual contribution.

(1) *Proc. Roy. Soc. Med.*, 1912 (Neur. Sect.), pp. 15–20.
(2) *Lancet*, 1907. i, p. 935.

Assistant Medical Officers in Asylums. By Dr. J. B. SPENCE, Medical Superintendent, Burntwood Asylum, Lichfield.

THE title of this brief paper will be familiar to many of you as the heading to letters which have recently appeared in several successive numbers of the *British Medical Journal.* Some of the letters have been signed with the full name of the writers, others with a pen name. They have all been characterised by moderation of language in the presentation of the case in which the writers and many others are deeply interested. For some time past I have felt strongly that something should be done to improve the position of assistant medical