Inheritance in Epilepsy

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A FIRST STUDY OF INHERITANCE IN EPILEPSY

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THE NEW JERSEY STATE VILLAGE FOR EPILEPTICS AT SKILLMAN

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A FIRST STUDY OF INHERITANCE OF EPILEPSY

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1. Statement of the Problem

Epilepsy is employed in this paper in a wide sense to include not only cases of well-marked convulsions, but also cases in which there has been only momentary loss of consciousness. Other, physically less marked cases of epilepsy and various epileptiform and border-line cases have undoubtedly been frequently overlooked in the necessarily somewhat hurried investigations into the pedigrees of patients. Given epilepsy as thus defined our problem is: what laws, if any, are followed in its occurrence in successive generations? How often does it arise *de novo* in a strain showing elsewhere no mental weakness? What relation does it bear to alcoholism, to paralysis, to migraine and to other symptoms of lack of neural strength? The answer to these questions can be reached only by a study of the pedigrees of families containing epileptics in which the psychic history of numerous members is precisely known.

2. The Material and the Method of Collecting It

This study is based on a lot of pedigrees of inmates of the New Jersey State Village for Epileptics at Skillman, N. J. The method by which they were obtained is important, for we are convinced that any advance we have been able to make in the difficult subject of inheritance of epilepsy is largely

due to it. These pedigrees were collected in major part by Mrs. D. Leucile Field Woodward, of the Skillman Village, and in minor part by Miss Saidee C. Devitt, of the Eugenics Record Office, while assigned to that village. These women visited the homes of patients, interviewed parents and other relatives, and physicians for the purpose of securing an accurate account of the mental history, environmental conditions, diseases and causes of death, if dead, of as many relatives as possible of the patient. The pedigree data thus obtained have proved to be much more significant and trustworthy than the familiar "family histories" commonly obtained from the patient or his guardian at the time of admission. Our data, we are convinced, approximate closely enough to the truth to warrant careful study, which is more than can be said for the ordinary "family history."

The number of separate pedigrees used in the present study has been 177. Two of these pedigrees were found to be connected with pedigrees that had been acquired earlier, so that there are only 175 separate families involved, and there is little doubt that further study will show some of these to be of the same blood. The number 175 gives no idea of the number of epileptics recorded in the pedigrees, since as many as 4 have been described in a single fraternity (full brothers and sisters), and several fraternities with epileptic individuals have been described in the same pedigree. In the tables that accompany this paper a single pedigree chart has sometimes yielded more than a single entry; on the other hand the data from 23 pedigree charts were altogether excluded because the mental condition of one or both parents of the principal fraternity was not ascertained by the field worker. The number of fraternities eventually considered in the following tables (each presumably descended from a single pair of parents) is 181. The total number of epileptics in the fraternities analysed is 206, but there were many other epileptics recorded in the charts who could not be used for study because of the fragmentary knowledge of their parentages and their sibs (i. e., brothers and sisters).

3. The Method of Analyzing the Data

This differs from that commonly employed hitherto in studies on the inheritance of human defects and diseases. Until recently it has been considered sufficient to determine in what proportion

of cases an epileptic was known to have epileptic ancestors ("direct heredity") or other relatives ("collateral heredity"). This proportion was then taken as the index of heredity. The index naturally increased as the study of the family was extended and so it is not surprising to find that the indices of heredity of epilepsy, determined by different workers, varies from 21 per cent. or lower to 75 per cent.

In this paper our data have been analyzed by the method commonly employed by biologists and known as the Mendelian method. This method assumes that the inheritance of any character is not from the parents, grandparents, etc., but from the germ-plasm out of which every fraternity and its parents and other relatives have arisen. The bodies of persons as we know them serve as (imperfect) indices of the nature of the germ-plasm from which they spring. The relation of soma and germ-plasm is as follows:

1. If the soma lacks a unit character upon which normal development depends that is *prima facie* evidence that the representative of that character is absent from its germ-plasm; consequently such a person cannot transmit the character in question.

2. If the soma has the unit character for normal development that is evidence that the germ plasm has the corresponding determiner. But either one of two cases is possible, (*a*) the determiner was derived from both sides of the house, so that it is double in the germ plasm (duplex, designated below by 2) and all the germ cells have the character; or else, (*b*) it came from one side of the house only, in which case it is single in the germ plasm (simplex, designated below by 1) and half of the germ cells have and half lack the character. The condition in the case when the determiner is absent may be called nulliplex (designated below by 0).

A moment's consideration will show that six kinds of matings, disregarding sex, are possible. These matings, together with the sort of offspring that they may be expected to yield, are indicated in the following table:

I, 0 × 0. All without the character of full mental development.
II, 0 × 1. 50 per cent. devoid of the character; 50 per cent. simplex.
III, 0 × 2. All with the character, simplex.
IV, 1 × 1. 25 per cent. with the character absent, 50 per cent. with it simplex; 25 per cent. with it duplex.
V, 1 × 2. 50 per cent. with character simplex; 50 per cent. with it duplex.
VI, 2 × 2. All with character duplex—mentally strong.

Practically, it is not always easy to distinguish the simplex from the duplex conditions, although frequently the simplex condition is indicated by an *intermediate* mental status. We may, however, construct six main tables, subsequently dividing the second into two parts, according as closely as possible with the probabilities in respect to germinal composition of the parents.

4. RESULTS.

In Table I there is only one mating with both parents epileptic (Fig. 1). There were three children of this mating about whose

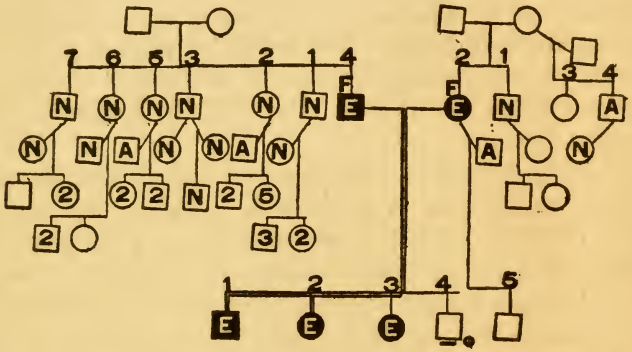

FIG. 1. Chart showing, at the bottom, the offspring of two epileptic parents. In this case both parents are likewise feeble-minded. Of the four children three are epileptic and No. 4 who died before he was fourteen was feeble-minded. Case 3669.

condition something is known; all were epileptic. There were five matings (see Figs. 4, 5, 6, 7) in which one parent was epileptic and the other feeble-minded; of the 14 offspring therefrom, 8 were epileptic and 6 feeble-minded. There were 6 matings of 2 feeble-minded parents (Figs. 8, 9, 29); and they yielded 21 known offspring. Of these 16 were feeble-minded and 5 were epileptic. It appears, consequently, that when both parents are epileptic, both feeble-minded, or one epileptic and the other feeble-minded all of the offspring will be either epileptic or feeble-minded, and the proportion of epileptics in any fraternity increases with that in the parentage. The rule that two feeble-minded parents have only offspring like themselves was apparrently first noted by one of us in 1909. The extensive and valuable data of Goddard (1910) offer several matings that accord with this rule. Through the kindness of Dr. Goddard we have

TABLE I.

The Frequency of the Different Classes of Mental Condition in the Children of two Mentally Defective Parents; together with the Mental Condition of the Grandparents, the Parents' Sibs (Brothers and Sisters) and Other Blood Relatives about Whom Something is Known.

Abbreviations.—A, alcoholic; ap, apoplexy; B, blind; bd, affected with Bright's disease; C, criminalistic; ca, cancerous; cb, childbirth; ch, choreic; cr, cripple; D, deaf; dau, daughter; dfm, deformed; dp, dementia præcox; dt, delirium tremens; dw, dwarf; dy, dropsical; E, epileptic; ec, eccentric; en, encephalitis; F, feebleminded; f, father; ff, father's father; fm, father's mother; go, göitre; gp, general paralysis of the insane; ht, heart disease; hy, hysteric; I, insane; id, ill defined organic disease; kd, kidney disease; la, locomotor ataxia; M, migrainous; m, mother; md, manic depressive insanity; mf, mother's father; mm, mother's mother; N, normal; Ne, neurotic; np, neuropathic; obs, obesity; P, paralytic; pa, paranoiac; pn, pneumonia; S, syphilitic; sb, softening of the brain; sc, scoliosis; sd, senile dementia; sh, shiftless; sm, simple meningitis; st, stillborn; su, suicide; Sx, unchaste; T, tuberculosis; tf, typhoid fever; tu, tumor; va, varicose veins; ve, vertigo; W, vagrant; x, unknown; ? implies doubt; † died.

Ser. No.	Children.												f	ff	fm	f's sibs.						Other f's relatives.						m	mf	mm	m's sibs.						Other m's relatives.					
	Total.	† early.	X	N	E	F	I	M	Ne	A	P	Sx				Total.	† early.	X	N	Ne	np	Total.	† early.	X	N	Ne	np				Total.	† early.	X	N	Ne	np	Total.	† early.	X	N	Ne	np
3669	4	.....	1	...	3	...	...	...	...	...	...	...	EF	dy	dy	6	.....	...	1	6	...	...	23	.....	21	1	1	...	EF	—	—	1	.....	...	1	...	...	7	.....	6	...	1^{1}	...
1286	8	.....	5	...	1	2	...	...	...	...	...	...	FA	—	—	.....	.....	...	...	...	...	...	.....	.....	...	...	...	...	F	—	—	.....	.....	...	...	...	...	.....	...	...	...	...
1745b	4	.....	...	...	4	...	...	...	...	...	...	...	F	†T	E	7	4	...	2	1^{3}	...	...	.....	.....	...	...	...	...	F	—	—	.....	.....	...	...	...	...	.....	...	...	...	...
2105	1	.....	...	...	1	...	...	...	...	...	...	...	F	—	†dy	.....	.....	...	...	...	...	...	11	3	5	2	...	1^{2}	F	A	—	2	.....	...	1	...	...	1	.....	...	1	...	...
3031	7	.....	...	...	1	6	...	...	...	...	...	...	F	N	N	6	2	...	2	2	...	...	.....	.....	...	...	...	...	FSx	—	FSx	.....	.....	...	...	...	...	1	1	...	...	...	...
3165	4	1^{E}	...	...	1^{E}	2^{F}	...	...	...	...	...	...	AFC	AC	—	5	.....	2	...	...	3^{T}	...	.....	.....	8	...	3^{E}	...	E	ACF	FSx	5	.....	2	...	...	3^{S}	.....	.....	...	...	...	...
4172	3	.....	...	...	1	2	...	...	...	...	...	...	F	†T	—	2	.....	1	...	1^{S}	...	...	.....	.....	3	...	...	1^{12}	F	A	—	4	2	...	1	1	...	90	8	65	5	8^{11}	4^{12}
584	1	.....	...	...	1	...	...	...	...	...	...	...	F	—	—	.....	.....	...	...	...	...	...	.....	.....	...	...	...	...	E	—	—	10	.....	9	...	1	...	10	.....	8	2	...	...
2847	7	3	...	...	3	1	...	...	...	...	...	...	F	...	...	3	.....	2	...	1^{13}	...	...	3	.....	3	...	...	...	E	—	—	2	.....	2	...	...	...	2	.....	2	...	...	...
2857	3	1^{16}	...	...	1	1	...	...	...	...	...	...	F	FC	?N	5	.....	1	...	3^{15}	1^{18}	4	2	2	.....	...	...	...	ESx	A	?N	5	1	1	...	2^{17}	1	12	6	2	4^{19}	...
3052	6	1	1	...	2	2	...	...	...	...	...	...	F	—	—	6	5	...	...	1^{19}	...	...	.....	.....	38	...	1^{20}	...	E	†P	—	4	1	...	1	2	...	12	.....	5	2	2^{21}	3^{22}
469	9	2	...	4	1	2^{23}	...	...	...	...	...	1^{24}	A1	—	—	5	3	...	1	...	1^{25}	23	.....	18	5	.....	...	...	E	—	—	1	.....	...	...	...	1^{28}	.....	.....	...	...	...	...
1372	6	.....	...	3	...	2	...	1	...	...	...	...	1^{27}	†P	—	11	7	...	3	...	1^{28}	9	.....	9	.....	...	...	...	FSx	—	—	.....	.....	...	...	...	...	.....	.....	...	...	...	...
4062b	2	.....	...	2	...	...	...	...	...	...	...	...	F	—	—	.....	.....	...	...	...	...	...	.....	.....	...	...	...	...	E^{29}	—	—	.....	.....	...	...	...	...	.....	.....	...	...	...	...

[1]A. [2]Chorea. [3]F. [4]"not bright." [5]anencephalic monster. [6]also F. [7]I also ESx. [8]2A, 1Sx, 1E, 2F. [9]alcoholic. [10]F. [11]1A. 2P. [12]1E, 1F, 2I. [13]Sx. [14]sb. [15]3A. 1 also W. [16]E. [17]1A, Sx, W, and 1 prob. defec. [18]all A. one also C. [19]F. [20]ch. [21]A. [22]E. [23]also 11 and 1C. [24]also C. [25]I. [26]E. [27]traumatic(?). [28]E. [29]Sister of m in 406a.

examined all of his data at Vineland. Thirty-five F × F matings yielded 142 known offspring—all feeble-minded.

Two important conclusions follow from these facts: First,

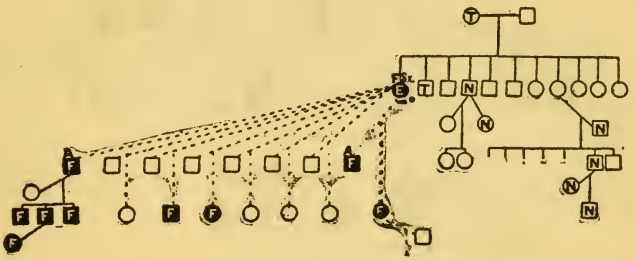

FIG. 2. This chart illustrates the *poorhouse source of defectives.* The central figure is an epileptic, feeble-minded, unchaste woman who had seven children, concerning six of whom something is known. Three of these died in infancy; the remainder are defective. The mother was taken from the almshouse, where she had spent a good share of her life, to keep house for a feeble-minded man and his three feeble-minded sons. One of this man's sons married a feeble-minded sister of one of the patients at the State Village. As a commentary on the condition of an almshouse this chart is eloquent. Case 584.

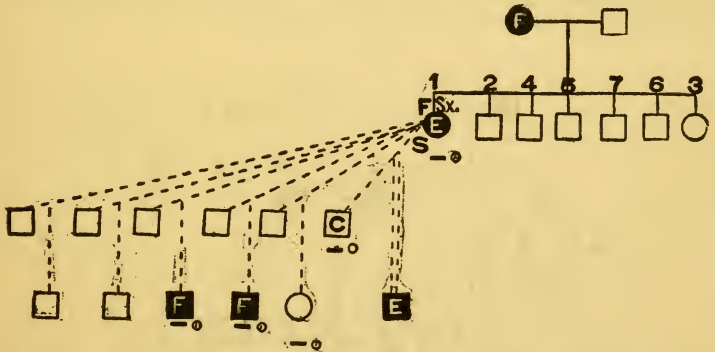

FIG. 3. This chart illustrates again the *poorhouse source of defectives.* The central figure is a feeble-minded woman, subject to epileptic fits, descended from a feeble-minded mother and shiftless, worthless father. She has spent most of her life in the almshouse and all of her children have been inmates. One is by a negro whom she met in the almshouse. Two of the children died in infancy; one, of whom little is known, died at 18. Of the remainder, two are feeble-minded and one, from a sire with criminal tendencies, is an epileptic imbecile. Case 829.

imbecility and epilepsy depend on the absence of factors that are very closely akin. At least, two feeble-minded parents may produce a large proportion of epileptic children. Second, when the soma of the parents shows bottom conditions their germ-plasm

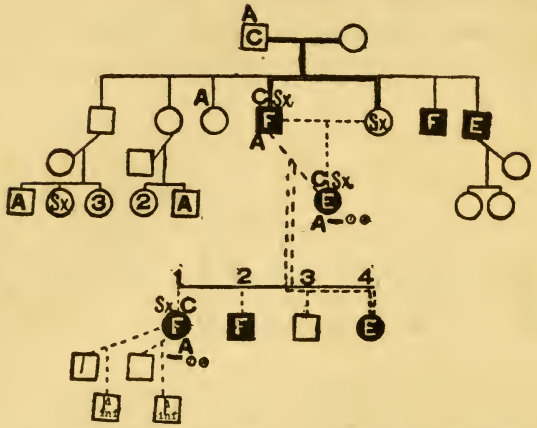

FIG. 4. This chart illustrates the *hovel source of defectives.* A feeble-minded man had by his defective sister an epileptic daughter with criminal instincts; then by this daughter he had four children, two feeble-minded, one epileptic and the fourth an anencephalic monster who died directly after birth. The empty germ plasm yields only emptiness. These things were done in a little hut in the woods until it burned down and now mother and eldest daughter, when not in the county jail or the Monmouth County almshouse, live in a cellar in town. The man is dead; but some of his protoplasm is living and at large. Case 3165.

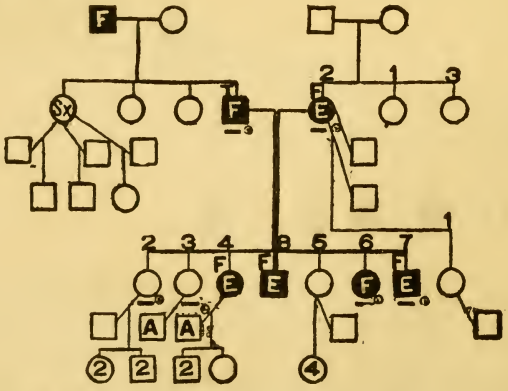

FIG. 5. In this chart the central mating is of two feeble-minded persons. The father had, in turn, a feeble-minded father. He himself is a drug fiend and, like his wife, has lived in an almshouse (2). His sister was a lewd woman and had three illegitimate children. There are seven offspring born between 1872 and 1892. Nothing is known of number 5 except that she has four children. Nos. 2 and 3 were at the almshouse; the other four are also feeble-minded, and three of them epileptic in addition. The two youngest are in a "children's home." There are eleven children coming on in the rising generation. Case 2847.

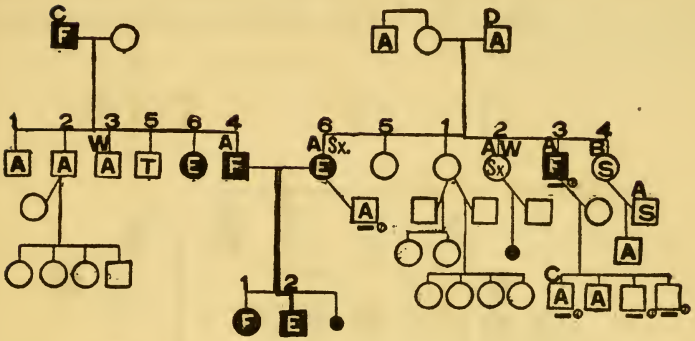

FIG. 6. This chart shows the product of a feeble-minded man and an epileptic, opium-eating, unchaste woman. The father's father was feeble-minded and a "criminal" and, besides the man in question, he had an epileptic son, and three alcoholics, of whom one had the vagrant tendency (W). The mother's germ-plasm does not show up much better, for she has a feeble-minded and alcoholic brother, who lives at the almshouse, an alcoholic sister who is a prostitute and a vagrant, and three alcoholic nephews of whom one (C) has been in jail (4). Two children were born alive to this pair 35 odd years ago. The first was feeble-minded and died before she was fourteen, the second is at the State Village for Epileptics. Case 2857.

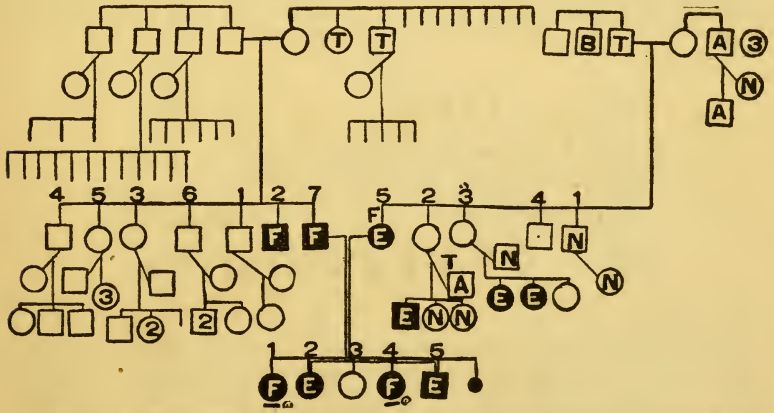

FIG. 7. The central mating is that of a feeble-minded man (who has a feeble-minded brother) and a feeble-minded and epileptic woman (who has three epileptic nephews and nieces, and belongs to a fraternity of neuropaths). Five children were born alive, of whom two are in an institution for the feeble-minded, two at the Skillman Village for Epileptics and the other, a nine-year old, has defective speech. The feeble-minded children are approaching an age when, upon demand of the father, they may be set free on the community to continue the pedigree. Case 3052.

lies at the lowest stage and can not produce mentally strong children,—the children can not rise higher than the higher parent in this character.

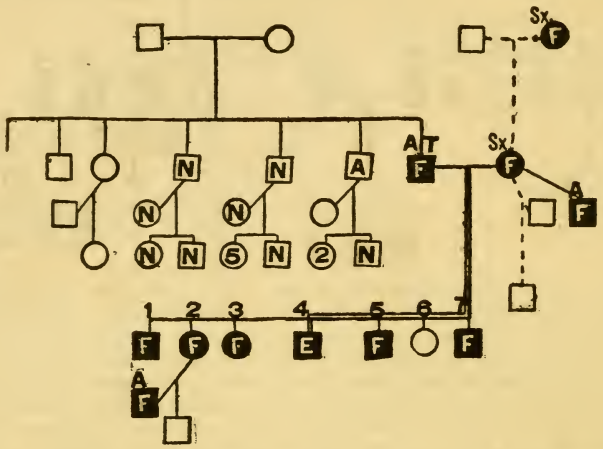

FIG. 8. This chart illustrates again the product of two feeble-minded parents. The father belongs to a fair strain except that his brother also is alcoholic. The mother, like *her* mother in turn, is immoral. There are seven children, of whom six are known. One of these is an epileptic at State Village and all of the others are feeble-minded. After the father's death the mother had an illegitimate child who died in infancy and she is now married to a feeble-minded and alcoholic man who is the younger brother of her daughter's feeble-minded husband. Case 3031.

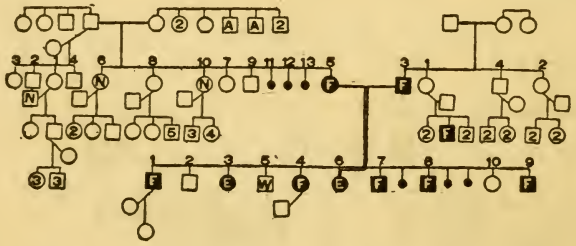

FIG. 9. Both parents are feeble-minded. Of their children ten were born alive. One is only three years old; one died at five years. All of the other eight are defective—two epileptic and six feeble-minded, including one confirmed runaway. This is a family of paupers living on the outskirts of the town in a barn to save rent. Case 3384.

In sharp contrast to the foregoing is the result of mating of one feeble-minded or epileptic parent with one who is "insane." Our collection shows 3 such matings. In one (Fig. 10) the insanity of the father (A) is probable. The father "is an intemper-

ate man and a baker by trade," always quarreling with his wife—"used to beat the mother and she always went about with a face very much bruised." This mating yields 1 normal to 3 defective in addition to others that are not known. In the second case the

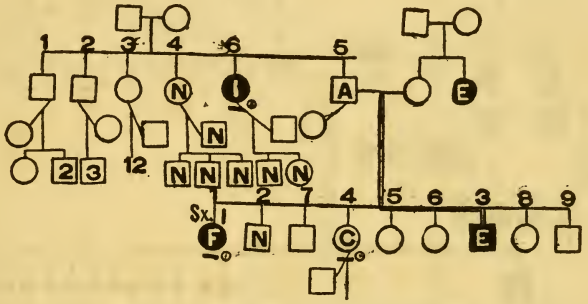

FIG. 10. The picture presented by this pedigree is quite different from the foregoing. The mother shows signs of epilepsy and has a certainly epileptic sister. The father belongs to a strain that shows insanity. His brother is in the state hospital and he himself is always quarrelsome and at times violent. "The whole family was a disturbing element in the town where they lived. The girls were immoral and the boys, who were implicated in a couple of local robberies, could never be trusted; so the people in the neighborhood were greatly relieved when they moved away." One boy is now at the State Village for Epileptics. His sister, No. 4, was at the state Home for girls and No. 1 is in an insane asylum. This whole fraternity seems to be unstable, neuropathic. Case 469.

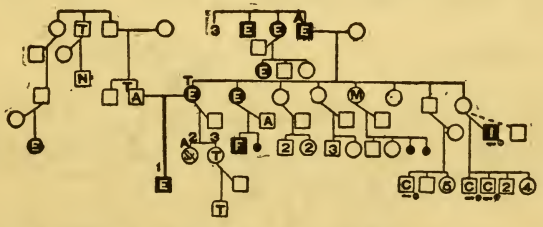

FIG. 11. This is a pedigree chart of a negro family whose maintenance is costing the State of New Jersey no small sum. The central mating shows an alcoholic man (who has an epileptic grand niece) married to an epileptic woman. Her father, and two of his sibs were epileptic. The woman has an epileptic sister and an epileptic cousin. She has one nephew in the state prison at Trenton, a brother-in-law in the state hospital there, two nephews in a state reform school and a daughter at the State Village. By another man she has a drinking immoral daughter and had another daughter who died of tuberculosis, leaving a son who at 17 has tuberculosis. Several of these feeble-minded and epileptic are still at large. Case 1643.

insanity (of the father) is said to be due to a fall after his marriage. This defect may be purely traumatic but, on the other hand, he has an epileptic brother and a feeble-minded niece, so

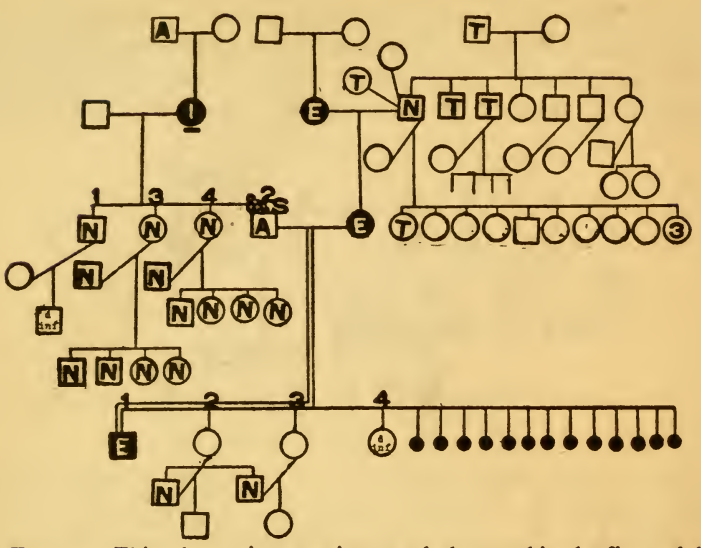

FIG. 12. This chart gives a picture of the combined effect of bad protoplasm and venereal infection. The central mating is between an epileptic woman (descended from an epileptic mother) and a sot, whose mother was insane and who is himself sexually immoral and infected both with gonorrhea and syphilis. The first child is epileptic, the next two are neurotic, No. 3 has hysteria, and No. 4 died in infancy. Then followed thirteen miscarriages, clearly due to the infection. In contrast with this result is that of two normal sisters of the father who married normal men and had, altogether, eight children, all normal. Case 1772.

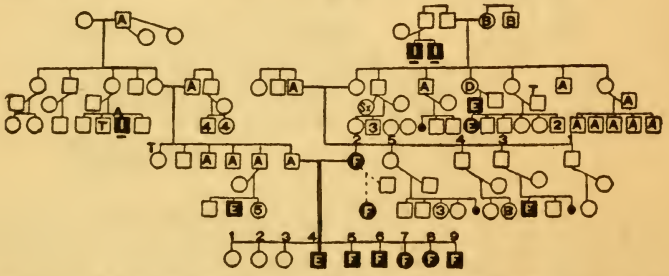

FIG. 13. In the central mating the mother is a feeble-minded woman who comes from a stock that is characterized by a high incidence of epilepsy, insanity and alcoholism. She had an illegitimate daughter who is feeble-minded, and then she married a man who is alcoholic himself, comes from a strain with many alcoholists, and has an insane cousin and an epileptic nephew. It seems probable that the father is mentally subnormal, and of the six children (out of nine) who did not die young one has epilepsy and the other five are feeble-minded. Case 2564.

there was probably an innate weakness and the fall is invoked as a convenient "cause." The 3 matings together yielded 19 off-

TABLE II.

THE FREQUENCY OF THE DIFFERENT CLASSES OF MENTAL CONDITION IN THE CHILDREN OF PARENTS ONE OF WHOM IS MENTALLY DEFECTIVE AND THE OTHER ALCOHOLIC; TOGETHER WITH THE MENTAL CONDITION OF THE GRANDPARENTS, THE PARENTS' SIBS AND OTHER BLOOD RELATIONS ABOUT WHOM SOMETHING IS KNOWN.

Abbreviations.—A, alcoholic; ap, apoplexy; B, blind; bd, affected with Bright's disease; C, criminalistic; ca, cancerous; cb, childbirth; ch, choreic; cr, cripple; D, deaf; dau, daughter; dfm, deformed; dp, dementia præcox; dt, delirium tremens; dw, dwarf; dy, dropsical; E, epileptic; ec, eccentric; en, encephalitis; F, feebleminded; f, father; ff, father's father; fm, father's mother; go, göitre; gp, general paralysis of the insane; ht, heart disease; hy, hysteric; I, insane; id, ill defined organic disease; kd, kidney disease; la, locomotor ataxia; M, migrainous; m, mother; md, manic depressive insanity; mf, mother's father; mm, mother's mother; N, normal; Ne, neurotic; np, neuropathic; obs, obesity; P, paralytic; pa, paranoiac; po, pneumonia; S, syphilitic; sh, softening of the brain; sco, scoliosis; sd, senile dementia; sh, shiftless; sm, simple meningitis; st, stillborn; su, suicide; Sx, unchaste; T, tuberculosis; tf, typhoid fever; tu, tumor; va, varicose veins; ve, vertigo; W, vagrant; x, unknown; ? implies doubt; † died.

Ser. No.	Children.										f	ff	fm	f's sibs.						Other f's relatives.						m	mf	mm	m's sibs.						Other m's relatives.					
	Total.	†early.	X	N	E	F	I	Ne	A	sx				Total.	†early.	X	N	Ne	np	Total.	†early.	X	N	Ne	np				Total.	†early.	X	N	Ne	np	Total.	†early.	X	N	Ne	np
624	11	4	...	3	2	2	...	...	...	...	A	?	?	...	...	...	...	...	...	...	...	...	...	...	F	?	?	5	...	2	1	2^1	...	5	...	5	...	...	...
1274	4	...	...	...	1	1	...	$1^?$	...	1	A	—	—	4	...	2	1	1	...	5	...	5	...	...	...	F	A	†ca	3	...	...	2	1	...	9	1	8	...	...	...
1319	2	...	...	...	1	1	...	...	...	...	A	—	1	6	...	...	5	1^d	...	18	2	13	...	2^d	1^d	F	—	F	...	...	...	...	...	...	22	1	20	...	1	...
2563	9	3	...	...	1	5	...	...	...	...	A	A	—	5	...	...	2	3^d	...	29	1	19	4	4^d	1^B	F	A	—	4	...	4	...	...	...	67	14	30^3	4	12^{1B}	$7^{1?}$
3189a	8	5	...	1	2	...	...	...	...	...	A	—	—	...	...	...	...	...	...	...	...	...	...	...	...	FA	—	—	3	...	1	$2^{1?}$	...	...	15	...	14	...	1^{1B}	...
3429	11	5	...	...	1	2	...	3	...	...	A	—	dy	5	1	...	2	2^{1d}	...	26	...	24	...	1	1^{1B}	F	—	dy	8	1	4	...	3^{1d}	...	15	2	13	...	...	...
3382	13	6	...	$1^{1?}$	2	3	...	1^{1B}	...	...	A	—	†P	3	...	...	3^{1B}	...	...	16	...	15	...	...	$1^{2?}$	F	A	†dy	8	5	1	2	...	...	36	2	$32^{1?}$	...	2^{1B}	...
4403b	3	...	...	...	...	...	...	...	...	...	A	—	—	...	...	...	...	...	...	...	...	...	...	...	...	F	—	—	...	...	...	...	...	...	...	...	...	...	...	...
1643	1	...	...	...	...	...	...	...	...	...	A	—	—	1	1	...	...	...	...	5	...	...	...	4	1^{2B}	E	E	†bd	7	1	...	4	1	1^{2B}	39	3	30^{1d}	2	...	4^{1B}
1662	5	4	...	...	1	...	...	...	...	...	A	—	A†P	11	...	...	11	...	...	3	...	...	...	3	...	E	—	I	7	6	1	...	...	...	1	...	...	...	...	1^{1B}
1772	17	14	...	...	1	...	...	2	...	...	ASx	—	I	3	...	...	3	...	...	11	1	1	8	1	...	E	N	E	—	...	...	...	...	...	22	9	$13^{2?}$	...	...	...
1976	8	2	2	2	1	...	...	1	...	...	AD	—	—	...	...	...	...	...	...	10	...	3	4	2	1^{2B}	$E^{2?}$	I^{2B}	†ca	6	1	3	2	...	...	21	...	17	1	2	1^{1B}
2483b	2	...	...	...	2	...	...	...	...	...	A	—	—	...	...	...	...	...	...	...	...	...	...	...	...	E	P	M	11	2	...	3	5	1^{2B}	29	...	16	5	3	5^{2B}
2601	3	...	...	...	1	2	...	...	...	...	A	—	—	...	...	...	...	...	...	...	...	...	...	...	...	EF^{2B}	—	†P	8	...	...	6	2^{1B}	...	21	...	20	...	...	1^{2B}
2769	12	2	3	3	3	...	...	1	...	...	$A^{2?}$	—	—	6	...	3	2	1	...	13	...	10	...	2^{1B}	1^{2B}	E	—	—	6	...	...	...	...	...	19	...	19	...	...	...
3104	3	...	1	1	1	...	...	...	...	...	A	—	—	...	...	...	...	...	...	...	...	...	...	...	...	E	—	—	...	...	...	...	...	...	...	...	...	...	...	...
3803	7	5	...	...	1	1	...	...	...	A	?ap	—	—	4	1	2	...	1^{2B}	...	8	1	5	2	...	...	EI	—	—	3	...	1	1	1^{2B}	...	11	...	10	...	1^{2B}	...
4062	3	...	2	...	1	...	...	...	...	...	A	—	—	3	...	...	3	...	...	4	...	3	...	...	1^{2B}	E	I	—	8	2	...	1	3^{2B}	2^{1B}	34	8	14	7	1	4^{2B}
4676	5	2	...	...	1	...	...	2	...	...	A^{2B}	1	—	4	2	...	1	1	...	6	...	6	...	...	...	E	†bd	†ca	10	...	...	10	...	...	...	...	...	...	...	...
2487c	4	...	...	...	1	3	...	...	...	...	A	—	—	4	...	2	1	2	...	39	2	19	8	7	$3^{1?}$	I	I	—	...	...	...	...	...	...	...	...	...	...	...	...
3515	3	...	1	1	1	...	...	1	...	...	A	—	—	...	...	...	...	...	...	...	...	...	...	...	...	I	I	I	4	...	3	...	1^{1B}	1	...	...	...	...	...	1^{1B}

[1]A, 1Ne. [2]lies. [3]P. [4]A. [5]F. [6]A, ?1A, †P. [7]E. [8]3B, 1D. [9]9A, 2Nc, 1 su. [10]4E, 1F, 2I. [11]A. [12]E. [13]1†P, 1Ne. [14]at 3 mos, spasms. [15]1fen. [16]?N, 13 yrs. old. [17]stubborn, to 4th grade in school. [18]1†dy. [19]F. [20]1†ca. [21]P. [22]E. [23]C. [24]3E, 1F. [25]E. [26]1†ca. [27]ca. [28]1A, isco. [29]F. [30]A. [31]su. [32]E. [33]1A, C. [34]1E, 1I. [35]3E, 1I. [36]also Ne. [37]E. [38]F.

[39]during pregnancy. [40]sd, †hd. [41]E. [42]I. [43]1E, 3F, 1I. [44]ca. [45]A. [46]E. [47]ca. [48]1A, isco. [49]F. [50]A. [51]su. [52]E. [53]1A, C. [54]1E, 1I. [55]3E, 1I. [56]also Ne. [57]E. [58]I. [59]F.

TABLE III.

THE FREQUENCY OF THE DIFFERENT CLASSES OF MENTAL CONDITION IN THE CHILDREN OF PARENTS ONE OF WHOM IS MENTALLY DEFECTIVE AND THE OTHER HAS APPARENT *Neurosis*; TOGETHER WITH THE MENTAL CONDITION OF THE GRANDPARENTS, THE PARENT'S SIBS, AND OTHER BLOOD RELATIVES ABOUT WHOM SOMETHING IS KNOWN.

Abbreviations.—A, alcoholic; ap, apoplexy; B, blind; bd, affected with Bright's disease; C, criminalistic; ca, cancerous; cb, childbirth; ch, choreic; cr, cripple; D, deaf; dau, daughter; dfm, deformed; dp, dementia præcox; dt, delirium tremens; dw, dwarf; dy, dropsical; E, epileptic; ec, eccentric; en, encephalitis; F, feebleminded; f, father; ff, father's father; fm, father's mother; go, göitre; gp, general paralysis of the insane; ht, heart disease; hy, hysteric; I, insane; id, ill defined organic disease; kd, kidney disease; la, locomotor ataxia; M, migrainous; m, mother; md, manic depressive insanity; mf, mother's father; mm, mother's mother; N, normal; Ne, neurotic; ap, neuropathic; obs, obesity; P, paralytic; pa, paranoiac; pn, pneumonia; S, syphilitic; sh, softening of the brain; sco, scoliosis; sd, senile dementia; sh, shiftless; sm, simple meningitis; st, stillborn; su, suicide; Sx, unchaste; T, tuberculosis; tf, typhoid fever; tu, tumor; va, varicose veins; ve, vertigo; W, vagrant; x, unknown; ? implies doubt; † died.

Ser. No.	Children.										f	ff	fm	f's sibs.						Other f's relatives.						m	mf	mm	m's sibs.						Other m's relatives.					
	Total.	†early.	X	N	E	F	I	Ne	A	Sx				Total.	†early.	X	N	Ne	np	Total.	†early.	X	N	Ne	np				Total.	†early.	X	N	Ne	np	Total.	†early.	X	N	Ne	np
4103	8	2	2	...	...	1	...	3	...	...	FA	—	—	6	...	3	...	2^1	$1^?$	15	—	10	...	$5^?$	...	M	—	E	4	1	3	...	...	...	7	...	7	...	...	...
3906	6	2	1	2	...	...	...	1	...	...	E	—	—	0	...	...	...	...	...	2	...	...	...	...	...	M	—	—	6	...	6	...	...	...	2	...	2^3	...	...	...
4078	4	...	...	2	1	...	...	1	...	...	E^1	A	A	2	...	...	$2^?$	...	...	31	3	20	$2^{6?}$	...	...	ch	†P	†ca	8	...	3^1	2	1^2	...	34	...	14	6	$9^{1?}$	$5^{1?}$
835	8	...	$5^{1?}$	1	2	...	...	...	...	...	E	—[14]	—	5	4^{1d}	...	...	...	1^{1B}	13	1	12	...	...	...	†P	A	?	14	13	1	...	...	...	5	...	4^{1B}	1	...	...
1174	20	1	12	5	1	...	...	...	1	...	†P	—	—	4	1	2	1	...	...	...	...	...	...	...	...	E	?N	†ap	3	...	$1^{1?}$	1^{1B}	1^{1d}	...	14	...	6	4	1	3^{2D}
2015 } 4369 }	6	3	...	2	1	...	...	...	...	...	P	A	?N	4	...	...	...	3	1^{2I}	22	1	19	...	1	1^{2B}	E	?	I	4	2	...	2	...	43	2	28	3	1	9^{2D}
473	5	1	...	2	1	...	...	...	1	...	E	?A[14]	—	7	2	...	2	3^{2B}	...	12	...	...	1	10	1^{2B}	...	Ne	N	N	1	...	...	1	...	...	2	...	...	2	...	...
3402	3	1	...	1	1	...	...	...	...	...	E	N	†ca	7	1	1	3	...	$2^{2?}$	34	2	29	...	3^{2B}	...	Ne	—	—	3	...	...	2	1^{2d}	...	19	7	10	2	...	...
4326	10	2	...	2	2	2	...	...	...	2	ESx	—	—	—	...	...	...	...	...	...	...	...	...	...	...	Ne	A	I	7	4	1	...	2^{3D}	...	2	...	12	2	3^{2I}	...
504 } 3781 }	6	...	...	2	1	...	...	3	...	...	Ne	?N	I	6	...	2	2^{2B}	2	...	46	...	2	34	5	5	E	N	?	2	2	...	...	...	...	...	...	...	...	...	...
1305	2	...	...	...	1	...	...	1	...	...	I	—	—	6	2	4	...	...	...	5	...	5	...	...	...	†P	—	—	...	...	...	...	...	...	...	...	...	...	...	...
2070	8	1	...	5	2	...	...	...	...	...	Ne	...	—	5	...	5	...	...	...	...	...	...	...	...	...	I	—	—	2	...	2	...	...	...	...	...	...	...	...	...

[1]A. [2]su. [3]C. [4]E. [5]allT. [6]"petit mal?". [7]ca. [8]5A, 1ch. [9]F. [10]4A, 2Ne, 2Sx, 1C. [11]E, 4F. [12]†ca. [13]†ca. [14]†tu. [15]F. [16]1cr, 1†ca. [17]sh. [18]P. [19]E. [20]1E, 2I. [21]E. [22]F. [23]6E, 3F. [24]obstruct. of intestine=ca?. [25]all A, 1†ca. [26]hy. [27]E. [28]2A, 1Ne. [29]ch. [30]1F, 1I. [31]2F, 1I. [32]rheumatism.

spring, of which 15 grew up and are known, and of these 9 were normal, 1 epileptic, 4 feeble-minded and 1 neurotic. Here, apparently "insanity" and feeble-mindedness are not due to the same missing factors and so some normal children result.

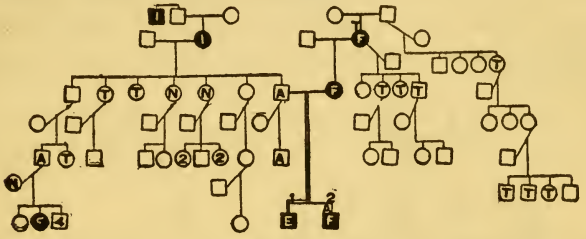

FIG. 14. The central mating is of a feeble-minded mother (of feeble-minded ancestry) with an alcoholic father (who has insane and feeble-minded relatives). The product is two children, one epileptic and one feeble-minded and alcoholic. Case 1319.

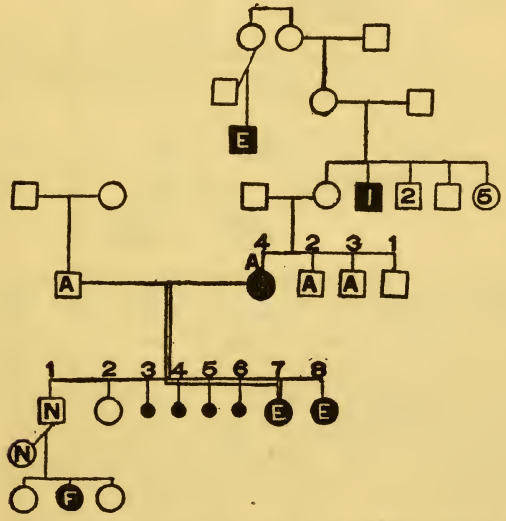

FIG. 15. The central mating is that of a feeble-minded and alcoholic woman to an alcoholic father about whose "blood" nothing more is known. There were eight children, four of whom were still-born, one died at ten years, two are epileptic and one is normal, but he has a feeble-minded daughter. Case 3189.

Table II comprises 21 fraternities derived from parents of whom one has defective mentality while the other is "alcoholic" (Fig. 10, 11, 12). Alcoholic here means "addicted to drink," "a heavy drinker," usually a sot. In this table are 8 matings of

a feeble-minded woman to an alcoholic man (Figs. 13, 14, 15). There were 61 offspring altogether, of whom 23 died early (an infant mortality of 38 per cent.). Of those that grew up 5 were normal (1 of these doubtfully so), 10 epileptic, 17 feeble-minded, 5 neurotic and one sexually immoral. This result is remarkable. It indicates either that some of the alcoholic fathers were also feeble-minded, while others had merely half of their germ cells

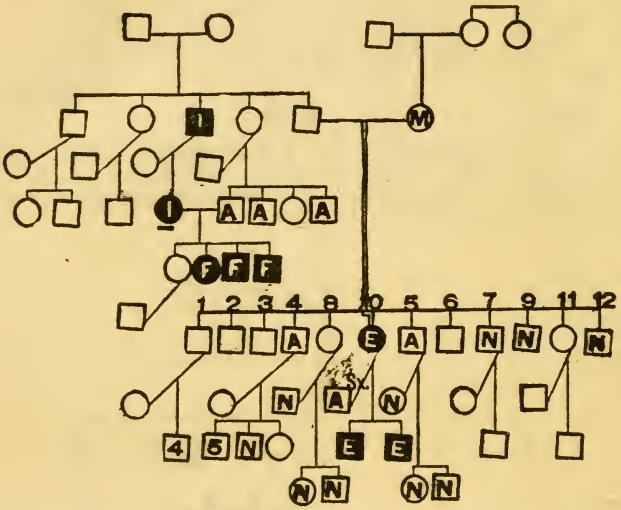

FIG. 16. This is a very instructive pedigree. The central mating near the top introduces us to a migrainous woman (of whose connections practically nothing is known) who marries a man of whom little is known except that he suffered from "paralysis" and that he had an insane brother and niece. Of the ten children who survived nothing is known of one. Of the other nine, three are normal, three neurotic, two alcoholic and one epileptic. This epileptic child marries an alcoholic and erotic man and has two epileptic sons. The insane niece, alluded to above, marries an alcoholic first cousin and has four children of whom three are feeble-minded and one died in convulsions, indicating a probable epileptic tendency. Case 2487.

defective; or there is another possibility that we shall discuss more fully below.

Table III comprises 12 fraternities containing epilepsy or feeble-mindedness in which one parent is feeble-minded or epileptic and in one case "insane," while the other shows some evidence of mental weakness, implied by the terms: migrainous, choreic, neurotic, and paralytic (Figs. 17, 18, 19). These fraternities comprise 86 offspring of whom details are known concerning about

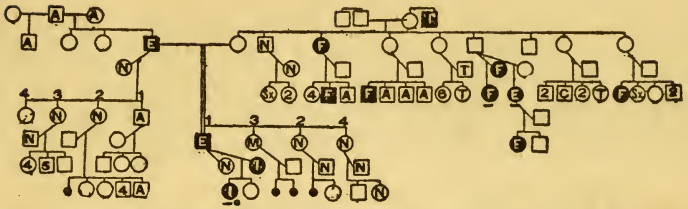

FIG. 17. The central mating is between an epileptic man (who died of paralysis) and a choreic woman (who had a feeble-minded sister), an insane uncle, and at least seven feeble-minded and epileptic nephews and nieces. There are four children; one epileptic, one migrainous and two normal. The epileptic has by an insane wife one insane and one neurotic child. Four institutional cases here. Case 4078.

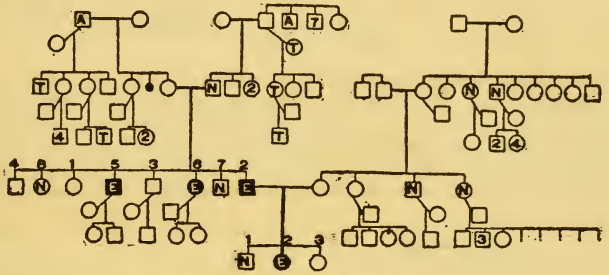

FIG. 18. The central mating is between an epileptic man (who has two epileptic sibs) and a neurotic mother (who has a sister and a niece with chorea). Of the two children old enough to classify one is epileptic and the other normal. Case 3402.

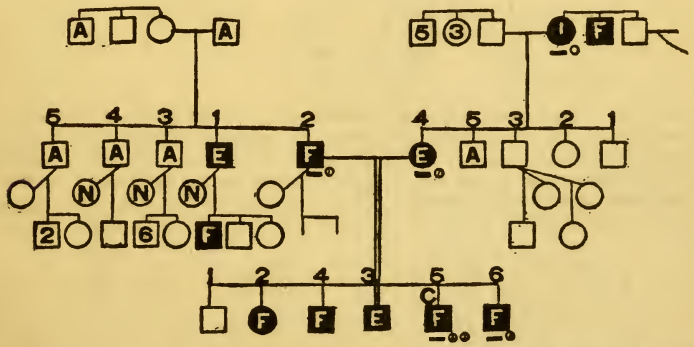

FIG. 19. This chart shows the product of an epileptic woman (whose mother was insane and uncle was feeble-minded) and a feeble-minded paralytic (who has an epileptic brother and a feeble-minded nephew). Of the six children one died in infancy, the others are all mentally defective. Six persons on this chart are or have been in the public care and three more should be. Case 4369.

53. Of these, 22, or something under half, are normal; 15 (a little over a quarter) are epileptic, 3 feeble-minded, 9 neurotic, 2 alcoholic and 2 sexually immoral. Of these tainted conditions migraine seems to be most closely related to feeble-mindedness, since none of the 7 offspring of defective migrainous matings are

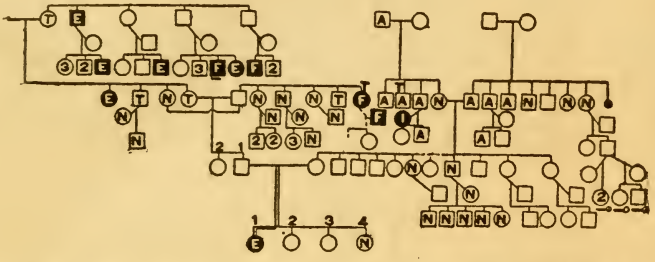

FIG. 20. This family has married into that of Fig. 19 and a grandson of the union has married into an alcoholic and neurotic strain. Of the four children one died when twenty years old of spinal meningitis (like her father), one is neurotic, one is epileptic and the youngest is normal. In the united families are thirteen persons who have been cared for in public institutions; and many others that should be. Case 2013.

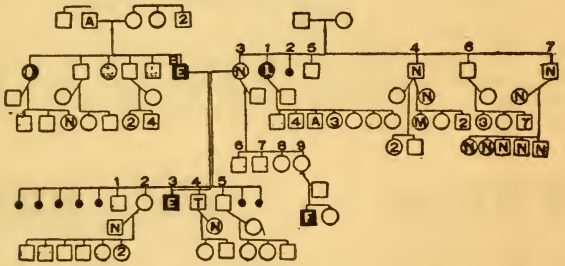

FIG. 21. The central mating is between a normal woman (who had an insane sister, and by a later marriage, a neurotic daughter and feeble-minded grandchild) and an epileptic man. There were seven miscarriages and five children, of whom one died in infancy, one is epileptic, one neurotic and one apparently normal. Most of the blank symbols represent children, who died in infancy; there are seventeen such children. Case 1395.

normal, though half are merely "neurotic." Altogether the result is about what is to be expected on the assumption that the tainted parent is simplex (i. e., has half his germ cells without the factor for full mental development). The deficiency of normals is due to the fact that some of the simplex offspring are neurotic.

Table IV shows the results of the marriage of a normal and

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Ser. No.	Children.									f	ff	fm	f's sibs.					Other f's relatives.					m	mf	mm	m's sibs.					Other m's relatives.				
	Total.	†early.	X	N	E	F	I	Ne	A	P				Total.	†early.	X	N	Ne	np	Total.	†early.	X	N	Ne	np				Total.	†early.	X	N	Ne	np.	Total.	†early.	X	N	Ne	np
829	7	I	3	I	I	I					N[1]														F												
1872c	6		5			I					N	—	—												F	—	†bd	5	2		2	I		49	II	22	I2		4[2]
2337	4	3[3]			I						N	—	—	II	I		I0			57	9	48				F	—		4			2	4[4]	9	5	3			I[5]
2685a	3			2	I						?N														F	?[6]	E										
4318	4	2	I	I							N	—	—	6	I		5			8	I		7			F[7]	†P	—	3			3			10	I	7	2		
4529	9		2	3	I	I		I[8]	I		?N	?	†P	7				4[9]	2	I[10]	38			35	I	2[11]	?F†bd	A	?	2				27		27			
666	I0		6	2	I					I	E	A	—						I[12]	0						N	N	N	7			2[13]	5		54		54			
866	3	I		I	I						E	—	—	I				I		2		2				?N	?	?											
1362a	3	I	I	I	I						E	I	†P	I				I		II	2	9				N													
1395	I2	8		2	I			I			E	A	N	5	2		2		I[14]	I7	2	I3	I	†ap		N	—	—	6	2		2	I[15]	I[16]	5I	8	I4	25	3	I[16]
2124	8	2		4	I			I			E	A	†P	II	4		6		I[18]	50	I2	I3	2	5	I[17]	N	—	—	5			2[18]	3		20	2	I4	4		
2207	7	I			2			4			N	†bd	—	4				4		28	I	I9	6	I	I[19]	E		E	5	I		I	2	I[20]	47	2	38			7[21]
2819	7	4		I	I			I			E	su	—[22]	—						23		I7		3[23]	3[24]	N	—	—	5			4[25]		I[25]	35	I	I4[26]	I4	5[27]	I[28]
3613a	5	I	I	2	I						?N														E[29]	—	—	3	2		I								
4326b	3			3							N														E	ESx	Ne											
4357	3	2			I						N	—	—	3				2	I[30]	8		8				?E[31]	—	—	3						I		I			
4392	I2	2			4	I		5			N	—	—	3			3									E[32]	†P	—	3			2[33]	I				I			
4270	I										E	—	—	9			8									N	—	E	I5	4		II			22	7	I4	I		
167b	6		4	2							†T															I[34]												
380	4		I[35]	I	I	I					I	?	I[36]	4[37]			3	I		44		33[38]	I0		I	?N[39]	†P	N	6			I	3	I[40]	I9	26		I9[41]		7[42]	
552	6		2	2	2						?T	?	?	2			2									sd[43]	?	?											
898	3		I	I	I						t.†bd	†kd	—	2			I	I		I0		I0				N[44]	?	?	9[45]		7	I	I[46]		72		6I[47]	4	3[47]	2[48]
1342	3	I			I[49]	I					I	—	—	I				I		35	4	I6	I2	I	2[50]	?dy	†T	†T	2	2				25		9	7	3	6[51]
1496	4	I	I		I						I[52]	—	—	6				6								?dy	—	—	2			2								

[1]lazy. [2]E, 3F. [3]all st. [4]E, 1F. [5]I. [6]unk. out of wedlock. [7]ca. [8]ch. [9]bd, t†P. [10]I. [11]C, illiterate. [12]E, [13]†bd. [14]. [15]P. [16]F. [17]E. [18]rbeum, 1†ca. [19]I. [20]su. [21]E, 1F, 1I. [22]E. [23]t†bd. [24]A. [25]P. [26]ca. [27]su. [28]E, 1F, 1I. [29]E. [30]bd, t†P. [31]E. [32]P. [33]ca. [34]I. [35]E. [36]ca. [37]all †P. [38]P. [39]ca. [40]D. [41]A. [42]8D. [43]ch. [44]E, 2F, 1I. [45]dw. [46]E, 1I. [47]E, 3I. [48]enc. [49]fainting spells. [50]ca. [51]sister's dau. to No. 361, mother. [52]also B. [53]SM. [54]sd. [55]3T. [56]3T, 1ca. [57]bd. [58]1ca. [59]F. [60]1ca. [61]all †P. [62]P. [63]ca. [64]D. [65]A. [66]8D. [67]ch. [68]E, 2F, 1I. [69]dw. [70]E, 1I. [71]E, 3I. [72]enc.

a defective. When the defective parent is feeble-minded, out of 17 known offspring 7 are normal; and when the defective parent is epileptic, out of 35 children 16 are normal (Figs. 21, 22, 23). In each case the normals are slightly fewer than the expected 50 per cent., doubtless because some of the simplex offspring are neu-

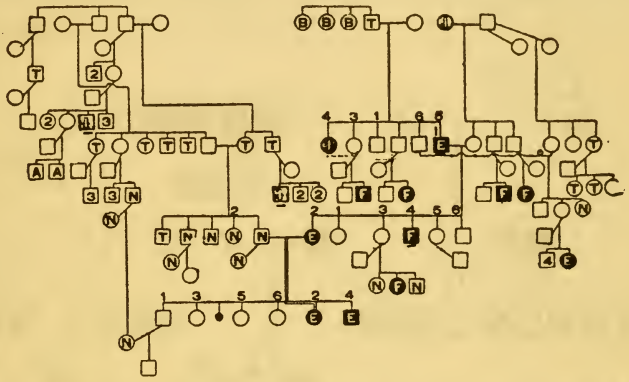

FIG. 22. This is the history of a family of intelligent people where there are many consanguineous marriages. Some fraternities consist wholly of normal persons but there are twelve fraternities containing one or more epileptic or mentally defective persons. An epileptic woman marries into one of the "wholly normal" fraternities and has two epileptic and four neurotic children. Case 2207.

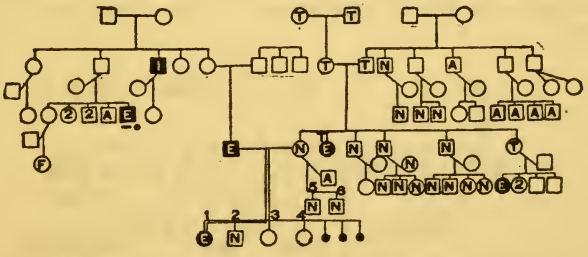

FIG. 23. A normal woman (who has an epileptic sister and an epileptic niece) marries an alcoholic man and has two normal children; but later, after she marries an epileptic man, there are reared one normal, one neurotic and one epileptic child. Case 2819.

rotic. Similarly with the normal × "insane" matings (Fig. 24). Now, by hypothesis, such matings should produce all normal (or neurotic) offspring *unless* in every case the normal parent is simplex and forms defective germ cells. We look therefore with interest at the condition of the families of these normal parents.

There are 24 of them; practically nothing more is known about the families of 11 of them. In the remaining 13 cases, there is positive evidence of nervous weakness in the families of 9, as shown in Table A. In the remaining 4 there is no evidence; however, negative evidence must be received with caution as information concerning mental weakness is sometimes withheld from the field worker. The nature of the epilepsy in the children of such

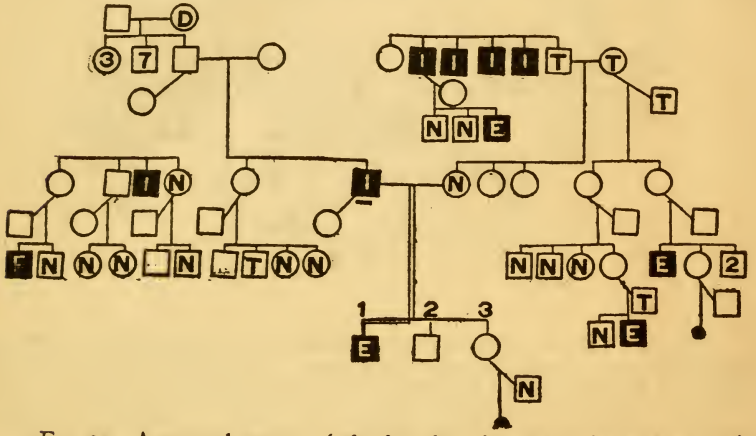

FIG. 24. A normal woman (who has four insane uncles and a cousin, a nephew and a grandnephew each epileptic) marries a man who is "insane" has one half brother insane and a nephew feeble-minded. Of the three children, one dies in infancy, one is a dwarf and one an epileptic. Case 1342.

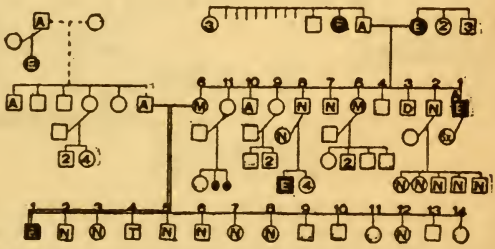

FIG. 25. Pedigree chart showing the product of a migrainous woman (whose mother, one brother and a nephew were epileptic and one aunt feeble-minded) and an alcoholic man (with epileptic half-sisters). This is a negro family; of fourteen children, five died in infancy, the first born was epileptic, the rest appear to be normal, though some are too young to predict their fate. Case 1579.

a normal parent from a normal family is not precisely known. Here, if anywhere in our tables, we might look for epilepsy induced by the powerful stimuli of syphilis or trauma.

TABLE V.

THE FREQUENCY OF THE DIFFERENT CLASSES OF MENTAL CONDITION IN THE CHILDREN OF PARENTS BOTH OF WHOM SHOW SOME EVIDENCE OF SLIGHT MENTAL WEAKNESS (INCLUDING ALCOHOLISM), TOGETHER WITH THE MENTAL CONDITION OF THE GRANDPARENTS, THE PARENTS' SIBS AND OTHER BLOOD RELATIVES ABOUT WHOM SOMETHING IS KNOWN.

Abbreviations.—A. alcoholic; ap, apoplexy; B, blind; bd, affected with Bright's disease; C, criminalistic; ca, cancerous; cb, childbirth; ch, choreic; cr, cripple; D, deaf; dau, daughter; dfm, deformed; dp, dementia præcox; dt, delirium tremens; dw, dwarf; dy, dropsical; E, epileptic; ec, eccentric; en, encephalitis; F, feebleminded; f, father; ff, father's father; fm, father's mother; go, göitre; gp, general paralysis of the insane; ht, heart disease; hy, hysteric; I, insane; id, ill defined organic disease; kd, kidney disease; la, locomotor ataxia; M, migrainous; m, mother; md, manic depressive insanity; mf, mother's father; mm, mother's mother; N, normal; Ne, neurotic; np, neuropathic; obs, obesity; P, paralytic; pa, paranoiac; pn, pneumonia; rh, rheumatism; S, syphilitic; sb, softening of the brain; sco, scoliosis; sd, senile dementia; sh, shiftless; sm, simple meningitis; st, stillborn; su, suicide; Sx, unchaste; T, tuberculosis; tf, typhoid fever; tu, tumor; va, varicose veins; ve, vertigo; W, vagrant; x, unknown; ? implies doubt; † died.

Serr. No.	Children.										f	ff	fm	f's sibs.						Other f's relatives.						m	mf	mm	m's sibs.						Other m's relatives.					
	Total.	† early.	X	N	E	F	I	Ne	A	P	Sx			Total.	† early.	X	N	Ne	np	Total.	† early.	X	N	Ne	np				Total.	† early.	X	N	Ne	np	Total.	† early.	X	N	Ne	np
1524	5	.....	...	3	I	I	.....	.....	...	.....	...	Ne	A†P	.....	6	.....	.....	I	5	...	22	2	19	.....	I		Ne	A	N	9	2	2	5	.....	.....	12	.....	10	2	.....	.....
2691	4	.....	...	2	2	.....	.....	.....	...	.....	...	Ne	†bd	I^{I}	I	.....	.....	I	.....	...	26^{2}	.....	26	.....	.....	.....	Ne	†ap	M	3	.....	.....	3	.....	.....	40	4	32	I	...	3^{3}
2791	5	3	I	...	I	.....	.....	.....	...	.....	...	Ne	A	—	—	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	Ne^{4}	—	N†dy	2	I	I	.....	.....	.....	16	.....	15	I	.....	.....
3592	7	I	I	2	2	.....	I	.....	...	.....	...	Ne	—	—	7	...	I	7	.....	...	.....	.....	.....	.....	.....	.....	Ne	—	†ap	3	.....	3	.....	.....	.....	3	.....	.....	2^{I}	I^{8}	.....
3951a	4	I	...	I	2	.....	.....	.....	...	.....	...	Ne	—	—	2	I	I	.....	.....	...	2	.....	I	.....	I^{7}	.....	Ne	—	P	8	.....	.....	7	I	.....	17	.....	I^{17}	.....	I^{8}	5^{8}
4286a	2	.....	...	.....	.....	2	.....	.....	...	.....	...	Ne	—	—	.....	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	Ne	M	M	8	3	.....	I	3	I^{10}	.....	.....	.....	.....	.....	.....
4475b	7	.....	...	5	I	.....	.....	I	.....	.....	...	Ne	—	—	.....	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	Ne	—	—	4	I	I^{11}	.....	2^{12}	.....	.....	.....	.....	.....	.....	.....
1716	5	I	...	2	I	.....	.....	.....	...	.....	I	M	A	—	9	.....	2	.....	4	3^{13}	49	5	39	I	3	I^{15}	M^{16}	A	N, D	10	I	3^{16}	5	I	...	50	3	43^{16}	.....	.....	4^{16}
4286	9	3	...	I	I	.....	.....	.....	...	.....	...	M^{18}	—	—	7	.....	4	I	2	...	7	.....	6	I	.....	.....	M	†bd	†ca	7	.....	5	2	.....	.....	29	.....	24	2	2^{18}	I^{18}
2041	7	.....	...	.....	4	.....	3	.....	...	.....	...	M	—	†P	I	.....	.....	I^{21}	.....	...	.....	.....	.....	.....	.....	.....	M	†P	N	7	.....	7	.....	.....	.....	.....	.....	.....	.....	.....	.....
514	6	.....	I	2	I	.....	.....	2	...	.....	...	Ne	N	†P	6	.....	3^{22}	3	.....	...	49	.....	49^{23}	.....	.....	.....	M Ne	N	.....	8	6	2	.....	.....	.....	41	.....	39^{23}	.....	.....	2^{23}
1561a	11	3	I^{24}	I	I	I	.....	2	2	.....	...	Ne^{25}	—	—	.....	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	M	A	E	3	.....	.....	$^{2}3$	.....	I	7	3	2^{27}	.....	.....
2924	4	.....	...	2	.....	2	.....	2	...	.....	...	Ne	.....	.....	5	2	I	.....	2^{26}	...	30	2	16	9	3^{26}	.....	M	†ca	5	I	.....	2	2^{26}	2	21	12	2	4	3^{26}	.....
3376	10	I	I	4	.....	.....	3	3^{26}	...	.....	...	Ne	—	—	7	.....	6	I^{26}	.....	...	7	.....	6	.....	I^{26}	.....	M	N, D	—	3	I	2^{26}	.....	.....	8	.....	8	.....	.....	.....
3641	8	6	...	I	I	.....	.....	.....	...	.....	...	Ne	—	—	3	.....	3	.....	.....	...	6	.....	6	.....	.....	.....	M	A	B	8	3	.....	3	2^{26}	.....	12	.....	7	5	.....	.....
4002b	6	.....	...	4	.....	.....	2^{27}	.....	...	.....	...	M	N	—	5	.....	I	3	I^{28}	...	.....	.....	.....	.....	.....	.....	Ne	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2673	8	I	...	3	I	I	.....	2^{23}	...	.....	...	A	—	—	7	.....	3	2	I^{26}	...	4	.....	2	I	.....	I^{26}	Ne	—	E	6	3	I	2	.....	.....	8	3	I	4	.....	.....
3689	7	4	...	2	I	.....	.....	.....	...	.....	...	ANe	rh	—	7	I	5	I^{26}	.....	...	2	.....	2	.....	.....	.....	Ne	Ne	3	I	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....
3171	13	5	...	3	2	.....	3^{29}	.....	...	.....	...	A	A	†bd	2	.....	.....	2	.....	...	6	.....	4	.....	2^{26}	.....	Ne	N	.....	.....	.....	2	.....	.....	2	.....	.....	.....	.....	.....	.....
1084	2	.....	I	...	I	.....	.....	.....	...	.....	...	A	N	†bd	3	.....	3	.....	.....	...	0	.....	.....	.....	.....	.....	Ne	.....	†dy	3	3^{26}	.....	.....	.....	.....	2	.....	I	I	.....	.....
1841	10	4	...	5	I	.....	.....	.....	...	.....	...	A	A	B†ap	.....	.....	.....	.....	.....	...	7	.....	5	.....	I^{26}	.....	Ne	A†dy	N	6	.....	.....	5	I^{26}	17	4	10	2	.....	I^{27}
3211	I	.....	...	I	.....	.....	.....	.....	...	.....	...	A	—	—	I	.....	.....	.....	I^{26}	...	.....	.....	.....	.....	.....	.....	Ne	—	N, D	6	.....	I	5^{26}	.....	.....	.....	.....	.....	.....	.....	.....
3794	7	2	...	4	I	.....	.....	.....	...	.....	...	A	†T	rh	2	.....	.....	2	.....	...	.....	.....	.....	.....	.....	.....	Ne	rh	6	.....	I	4	I^{26}	.....	10	.....	9	.....	.....	I^{31}
4402	9	3	...	3	I	.....	I	I	...	.....	...	A	—	—	I	.....	.....	I^{32}	.....	...	7	.....	I	.....	.....	.....	Ne	—	—	7	I	4	.....	2	.....	19	.....	16	.....	3^{32}	.....
3556	10	5	...	3	I	.....	.....	I	...	.....	...	A	Ne	—	3	I	.....	I	I	...	10	.....	6	2	2^{26}	.....	Ne	—	N	4	.....	3	I^{26}	.....	.....	15	.....	14	.....	.....	I^{26}
3921	7	4	...	.....	I	.....	.....	2^{26}	...	.....	...	A, S	A	—	5	.....	2	3^{26}	.....	...	8	3	5	.....	.....	.....	M	A	A	4	I	2	.....	I^{26}	.....	3	I	2	.....	.....	.....
2029	4	.....	...	I	I	.....	.....	2^{26}	...	.....	...	A	A	A†bd	N	2	I	.....	I	...	86	9	60	10	3	4^{26}	M	—	3	3	.....	.....	.....	.....	86	3	78	2	I	2^{26}
1579	14	4	2	7	I	.....	.....	.....	...	.....	...	A	A	—	5	.....	4	I	.....	...	7	.....	6	.....	I^{26}	.....	M	A	E	10	I	3	3	2	I^{26}	40	6	27	5	.....	2
4912	3	2	...	.....	I	.....	.....	.....	...	.....	...	A, rh	—	M, P	4	.....	.....	4	.....	...	9	.....	.....	9	.....	.....	MNe	—	†P	5	.....	5	.....	.....	.....	.....	I	I	.....	.....
402a	I	.....	...	.....	I	.....	.....	.....	...	.....	...	†ap	†rh	.....	8	.....	6	.....	I	I^{26}	5	.....	3	2	.....	.....	Ne	A	N	3	.....	3^{33}	.....	.....	.....	I	.....	.....	I	.....	.....
2013b	4	I^{26}	...	I	I	.....	.....	I	...	.....	...	†sm	Ne	†T	I	I	.....	.....	.....	...	63	8	32	8	I^{26}	I^{26}	Ne	A	N	10	5	3	2	.....	.....	42	3	23	8	8^{26}	.....
4363a																																								
3614	11	2	...	3	4	.....	I	.....	I	.....	...	A	I	—	13	I	7	.....	4	I^{27}	49	3	41	.....	5^{26}	.....	by	—	†P	6	I	3	.....	2^{26}	.....	25	4	16	2	I^{26}	2^{26}
1682	9	2	...	4	2	.....	.....	I	...	.....	...	A†bd	—	—	I	.....	I	.....	.....	...	6	.....	6^{26}	.....	.....	.....	†P	—	†dy	5	.....	2	I^{26}	.....	.....	2	2	.....	.....	.....	.....
1852	8	2	...	2	3^{26}	.....	I	.....	...	.....	...	ASxI^{29}	A	A	—	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	Sx	A	†T	2	.....	.....	2	.....	.....	5	.....	I	3	I	.....
643a	17	10^{34}	I	4	I	.....	.....	I	...	.....	...	A	E	N	4	I	2	I^{26}	.....	...	22	.....	.....	10	10	2^{26}	A	.....	.....	0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1162	2	.....	...	.....	I	.....	.....	.....	...	.....	...	A	—	—	I	.....	.....	.....	.....	...	2	I	.....	.....	I^{27}	A	.....	†T	I	.....	I	.....	.....	.....	.....	10	.....	10	.....	.....	.....
2487a	12	2	...	3	I	.....	I	4^{29}	I	.....	...	P	—	—	4	.....	.....	.....	.....	...	I^{29}	I3	.....	5	3	5^{26}	M	—	—	I	.....	I	.....	.....	.....	.....	.....	.....	.....	.....	.....
242	8	.....	3	3	I	7^{35}	.....	.....	...	.....	...	†P	B	—	6	.....	5^{32}	I	.....	...	.....	.....	.....	.....	.....	.....	P	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....
1872a	12	7	...	3^{26}	I	I	.....	.....	...	.....	...	†P	B	—	2	.....	2	.....	.....	...	.....	.....	.....	.....	.....	.....	†P	—	—	I	.....	I	.....	.....	.....	I	.....	I	.....	.....	.....

[1]sd†ca. [2]†hd, †dfm. [3]I, 2E. [4]P. [5]F. [6]E. [7]?T, †[8]ca. [9]P. [10]E, 2I. [11]E. [12]†ca. [13]A, I M. [14]F, [15]†ca. [16]†ca. [17]E, 3F. [18]Ne, 1ch. [19]†bd. [20]A, 1Ne. [21]E. [22]M. [23]D, 1rh. [24]†en, †[105 yrs. [25]I ap, I dy, 1 en. [26]F, I[I], [27]rh. [28]F, I su. [29]ch, 1P. [30]A, 1ch. [31]convulsions at cb. [32]shy, I also ca. [33]palsy, †M, 1P. [34]P. [35]Sx. [36]tap. [37]A. [38]M. [39]E (400 a, son). [40]ch, †M. [41]E, 1I. [42]ht, †bd. [43]. [44]E, 6F. [45]. [46]D. [47]M. [48]E, 1I. [49]A. [50]E. [51]A. [52]D, 1rh. [53]†en, †[105 yrs. [54]I ap, I dy, 1 en. [55]F, I[I], [56]rh. [57]P, I su. [58]ch, 1P. [59]A, 1ch. [60]convulsions at cb. [61]shy, I also ca. [62]palsy, †M, 1P. [63]P. [64]Sx. [65]tap. [66]A. [67]M. [68]E (400 a, son). [69]ch, †M. [70]E, 6A. [71]. [72]A. [73]E. [74]P. [75]I also C. [76]dt. [77]All still born or † early. [78]Sx. [79]E. [80]?T, ?I su. [81]A. [82]†6mo. conv. [83]M, †N. [84]A. [85]C, I Ne. [86]2E, 2F. [87]F and C, I sd. [88]E. [89]. [90]dy. [91]sm. [92]I[I], 7E, 6F. [93]A. [94]. [95]A. [96]E. [97]D. [98]P. [99]I also C. [100]dt. [101]All still born or † early. [102]Sx. [103]E. [104]?T, ?I has spinal trouble. [105]sb. [106]I[I], 2E, 3F. [107]C?. [108]ca. [109]2bd.

Table V shows us the condition of the offspring of two parents both of whom fall into the tainted classes: neurotic, migrainous, alcoholic, hysteric, paralytic. Bunching this heterogeneous collection we find that of 186 classified offspring 82, or 44 per cent., are "normal"; about 30 per cent. are epileptic or imbecile and the remainder insane (2 per cent.) and tainted. Expectation is that 25 per cent. shall be epileptic or imbecile, and this expectation is approximately realized. The remainder are, as was to be expected, normal and tainted (Figs. 25, 26).

TABLE A.

SHOWING NERVOUS CONDITION OF RELATIVES OF NORMAL PARENTS IN TABLE IV.

Serial No.	Parent.	Total known.	N	E	F	I	Ne	A	P	Sx	ch
2337	f	10	10	.....	.....	.....	.....	.....	.....	...	...
4318	f	12	12	.....	.....	.....	.....	.....	.....	...	...
4521	f	7	1	.....	.....	1	4	.....	1	...	...
666	m	7	7	.....	.....	.....	.....	.....	.....	...	...
1395	m	33	27	.....	.....	2	3	.....	1	...	...
2129	m	7	7	.....	.....	.....	.....	.....	.....	...	...
2207	f	12	10	.....	.....	1	1	.....	.....	...	...
2819	m	25	18	2	.....	.....	5	.....	.....	...	...
4270	m	2	1	1	.....	.....	.....	.....	.....	...	...
4357	f	3	2	.....	.....	.....	.....	.....	1	...	...
380	m	14	4	.....	1	.....	8	.....	1	...	...
898	m	13	5	1	2	1	2	1	.....	...	1
1342	m	16	7	3	.....	3	3	.....	.....	...	...

It is a remarkable and significant fact that when both parents have the same class of taint the proportion of offspring of that class is not exceptionally high (Table B). The conclusion is that

TABLE B.

SHOWING THE PROPORTION OF TAINTED INDIVIDUALS OF ANY CLASS WHEN BOTH PARENTS BELONG TO THAT CLASS.

Father and Mother Both in the Class Named Below.	No. of Classified Offspring.	Proportion Normal.	Proportion with the Same Trouble as Parents.	Proportion with this Trouble in the Whole Population of Offspring.
Neurotic.....	27	48%	7%	15%
Migrainous (Fig. 26).....	17	18%	0	3%
Alcoholic.....	7	56%	0	3%
Paralytic.....	10	60%	0	0

the specific defect is not inherited as a unit; but only as a mental weakness.

Table V confirms in an interesting fashion the view now

generally entertained by students of psychopathology, that the majority of cases of migraine, chorea, paralysis, neurosis, alcoholism and prostitution are associated with nervous disease or nervous defect. The new fact that our study brings out is that

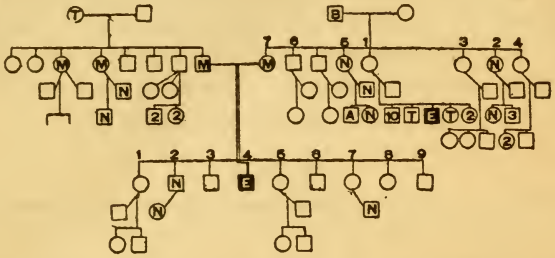

FIG. 26. The central mating of two migrainous persons. The father's side shows no defect but migraine, the mother's side shows epilepsy and the neurotic condition. Of the nine offspring three died very early, one is epileptic and the remainder are neurotic, choreic, and neurasthenic. One of the neurotic children (No. 1) married a neurotic man and they have two children, both neurotic. Case 4286.

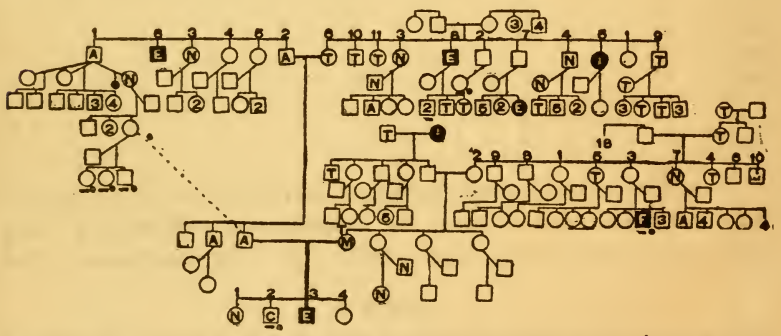

FIG. 27. In the next to the last generation we find a migrainous woman (whose father's mother had senile dementia and one of whose cousins was feeble-minded) married to an alcoholic unchaste man belonging to a highly neuropathic family. Of the four children one is normal, one neurotic, one criminalistic and one epileptic, who is at the State Village. This family has furnished nine inmates of institutions. Case 2029.

these tainted, nervous conditions are often if not usually simplex in the factor that makes for vigorous mentality; i. e., they arise from the union of a germ cell with and one without that factor.

Table VI yields facts of importance concerning the progeny out of matings between the "tainted" and "normals" in which epilepsy occurs. There are 47 fraternities from such matings (Figs. 28, 29, 30, 31). Expectation is that since epilepsy occurs

TABLE VI.

The Frequency of the Different Classes of Mental Condition in the Children of Parents One of Whom has Some Form of Neurosis and the Other is *Normal*; together with the Mental Condition of the Grandparents, the Parents' Sibs and Other Blood Relatives about Whom Something is Known.

Abbreviations.—A, alcoholic; ap, apoplexy; B, blind; bd, affected with Bright's disease; C, criminalistic; ca, cancerous; cb, childbirth; ch, choreic; cr, cripple; D, deaf; dau, daughter; dim, deformed; dp, dementia præcox; dt, delirium tremens; dw, dwarf; dy, dropsical; e, epileptic; ec, eccentric; en, encephalitis; f, feebleminded; f, father; ff, father's father; fm, father's mother; go, göitre; gp, general paralysis of the insane; ht, heart disease; hy, hysteric; i, insane; id, ill defined organic disease; kd, kidney disease; la, locomotor ataxia; M, migrainous; m, mother; md, manic depressive insanity; mf, mother's father; mm, mother's mother; N, normal; Ne, neurotic; np, neuropathic; obs, obesity; P, paralytic; pa, pneumonia; pn, pneumonia; rh, rheumatism; S, syphilitic; sb, softening of the brain; sco, scoliosis; sd, senile dementia; sh, shiftless; sm, simple meningitis; st, stillborn; su, suicide; Sx, unchaste; T, tuberculosis; tf, typhoid fever; tu, tumor; va, varicose veins; ve, vertigo; W, vagrant; x, unknown; ? implies doubt; † died.

Ser. No.	Children.											f	ff	fm	f's sibs.						Other f's relatives.						m	mf	mm	M's sibs.						Other m's relatives.					
	Total.	†early.	X	N	E	F	I	Ne	A	P	Sx				Total.	†early.	X	N	Ne	np	Total.	†early.	X	N	Ne	ep				Total.	†early.	X	N	Ne	np	Total.	†early.	X	N	Ne	ep
94	5	.....	3	1	1	.....	.....	.....	.....	.....	.....	M	†ca	†pn	6	.....	1	4^1	1	.....	18	.....	7	9	1^2	1^2	N	†ap	†P	2	.....	.....	2^4	.....	.....	7	.....	5	2	.....	.....
306	2	.....	.....	1	1	.....	.....	.....	.....	.....	.....	N, cr	.....	†P	2	.....	2^5	.....	.....	.....	5	.....	3	1	1^3	.....	M	Ne	†T	3	.....	2	1	.....	.....	13	.....	10	.....	3^7	.....
442	11	.....	6	1	3	1^6	.....	.....	.....	.....	.....	N	.....	.....	3	.....	3^6	.....	.....	.....	.....	.....	.....	.....	.....	.....	M	†T	†dy	9	.....	7	.....	1^{12}	1^{11}	.....	.....	.....	.....	.....	.....
674	3	.....	2	.....	1	.....	.....	.....	.....	.....	.....	N	A	N	1	.....	.....	1	.....	.....	26	.....	21^5	5	.....	.....	M	1	†bd	4	.....	1	.....	2^{13}	.....	54	.....	4^{17}	7	5^{13}	1^{16}
1149	10	6	.....	.....	1	.....	.....	2^{13}	.....	.....	.....	N	$†^{23}$	.....	6	2	3	.....	1^{21}	.....	9	2	6	.....	1	.....	M	.....	.....	6	.....	6	.....	.....	.....	2	2	.....	.....	.....	.....
1435	7	.....	1	5	1	.....	.....	.....	.....	.....	.....	†bd	†P	—	6	.....	5	.....	1^{23}	.....	29	.....	22	5	.....	2^{22}	M†P	—	—	4	.....	4^{34}	.....	.....	.....	13	3	9	.....	1	.....
4096a	12	.....	.....	11	1	.....	.....	.....	.....	.....	.....	N†bd	—	—	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	M	—	—	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1934b	2	.....	.....	1^{16}	.....	.....	.....	1^{24}	.....	.....	.....	ch	.....	†P	4	.....	3	1^{31}	.....	.....	11	.....	9	.....	.....	2	N	.....	.....	10	.....	3	7	.....	.....	18	.....	7	10	.....	1^{37}
145	11	.....	6	3	2	.....	.....	.....	.....	.....	.....	Ne	Ne	.....	8	.....	7	.....	1^{35}	.....	7	.....	7^{35}	.....	.....	.....	N	.....	.....	8	.....	6	.....	1^{31}	1^{30}	10	.....	6	2	2^{31}	.....
1672	8	.....	3	4	1	.....	.....	.....	.....	.....	.....	Ne	ec, W	N	1	.....	1	.....	1	.....	.....	.....	.....	.....	.....	.....	Ne	†T	1	6	.....	4^{33}	2	.....	.....	5	.....	5^{35}	.....	.....	.....
335	7	.....	1	3	1	2	.....	.....	.....	.....	.....	Ne^{34}	.....	.....	3	.....	3^{35}	.....	.....	.....	7	.....	1	1	3^{35}	2^{37}	N, D	.....	.....	1	.....	1	.....	.....	.....	23	.....	8	11	.....	4^{38}
1346a	10	.....	4	4	1	.....	1	.....	.....	.....	.....	N†bd	†su	.....	8	.....	4	.....	4^{35}	4	.....	.....	3	.....	1^{40}	Ne	N†T	D, rh	5	.....	2	3^{41}	.....	.....	20	.....	16	4	.....	.....
1132	4	.....	2	.....	1	.....	1	.....	.....	.....	.....	N	Ne	†T	4	.....	4	.....	.....	3	.....	.....	3	.....	.....	Ne	.....	.....	.....	6	.....	6^{42}	.....	.....	.....	.....	.....	.....	.....	.....	.....
1189	4	2	.....	.....	1	.....	1	1^{42}	.....	.....	.....	Ne	A	†T	3	.....	.....	2	1^{42}	.....	14	.....	7	6	.....	1^{42}	N, cr	—	—	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1451	8	2	1	3	2	.....	.....	.....	.....	.....	.....	†ca	A	—	5	.....	1	2	1^{42}	.....	12	.....	11	.....	.....	1^{42}	Ne	rh	—	9	3	4	1	1	.....	31	.....	30	.....	1^{42}	.....
1906	1	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	?N	—	—	2	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	Ne	.....	N	8	4	1	2	1	.....	13	2	8	3	.....	.....
2226	5	2	.....	2	1	.....	.....	.....	.....	.....	.....	?N	—	—	4	.....	4	.....	.....	.....	11	.....	11	.....	.....	.....	Ne	—	—	5	.....	5^{42}	.....	.....	.....	6	.....	1	5	.....	.....
2375	3	1	.....	1	1	.....	.....	.....	.....	.....	.....	?N	†ap	—	7	2	5	.....	.....	.....	11	.....	8	.....	2^{42}	1^{42}	Ne	.....	—	2	1	.....	1	.....	.....	22	.....	20	2	.....	.....
5041b	5	.....	2	1	1	.....	1	.....	.....	.....	.....	?N	N	1	4	.....	.....	3	1	.....	62	.....	4	41	11	6^{42}	Ne^{43}	†la	†ht	3	.....	1	2	.....	.....	15	.....	11	3	1	.....
3781b																																								
3624	3	.....	.....	2	1	.....	.....	.....	.....	.....	.....	N	—	—	5	.....	4	.....	1^{44}	.....	10	.....	7	2	1^{44}	.....	Ne	.....	—	2	.....	2	.....	.....	.....	38	2	34	.....	.....	2^{44}
4589	3	.....	.....	1	1	.....	1	.....	.....	.....	.....	N, rh	†ca	—	2	.....	1	.....	1^{44}	.....	23	1	17	.....	3^{44}	2^{47}	Ne	.....	1	7	.....	4	2	1^{44}	.....	69	13	43^{44}	10	3^{44}	.....
3128	4	1	1	1	1	.....	.....	.....	.....	.....	.....	?N	†ap	.....	6	.....	5^{44}	.....	1^{44}	.....	15	.....	1^{47}	.....	.....	.....	N	†P	.....	6	.....	5^{44}	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
3140	5	.....	2	3	.....	.....	.....	.....	.....	.....	.....	?N	†ap	.....	2	.....	5^{44}	.....	†P	.....	15	.....	3^{45}	12^{44}	.....	.....	?N	.....	.....	2	.....	2^{47}	.....	.....	.....	8	.....	1	5	.....	2^{44}
1705	8	1	.....	2	1	.....	3	.....	1	†P	.....	A	†P	1	.....	.....	.....	1^{45}	.....	.....	.....	.....	.....	.....	.....	N	N	†bd	11	4	1	6	.....	.....	46	7	30	5	2	2^{70}
2153	6	.....	.....	4	1	1	.....	.....	.....	.....	.....	A, P	—	Ne	5	.....	.....	5	.....	.....	19	.....	19	.....	.....	.....	rh	—	—	8	.....	8	.....	.....	.....	.....	.....	.....	.....	.....	.....
2557	3	.....	2	1^{71}	.....	.....	.....	.....	.....	.....	.....	N	—	—	6	.....	4^{72}	2	.....	.....	31	.....	28	2	1^{73}	.....	†ap	.....	.....	5	.....	.....	5	.....	.....	18	.....	16	2	.....	.....
4092b	3	.....	2	1	.....	.....	.....	.....	.....	.....	.....	†ap	†rh	.....	8	.....	6	1	1^{74}	.....	6	.....	3	2	1	.....	N	.....	.....	2	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....
83	4	.....	1	1	.....	2	.....	.....	.....	.....	.....	B	†P	va	4	.....	.....	3	1	.....	3	.....	.....	3^{75}	.....	.....	P, rh	A	.....	5	.....	1	4	1	.....	2	.....	.....	.....	2	.....
1475	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	?N	?N	†P	5	1	.....	3	1	.....	12	6	.....	6	.....	.....	Sx	A	†P	8	3	.....	.....	4^{75}	1^{77}	4	3	.....	1	.....	.....
481	5	1	2	1	1	.....	.....	.....	.....	.....	.....	A	.....	.....	7	.....	1	5^{76}	1	.....	25	.....	21	1	2	1	?N	†P	†T	8	.....	2^{73}	4	1	1^{34}	10	.....	2	8	.....	.....
977	9	.....	.....	4	2	3	.....	.....	.....	.....	.....	A	A	P	11	1	4	2	4^{51}	1^{76}	38	.....	15	5	9	9	?ND	N	†bd	12	.....	7	3	2^{34}	.....	9	A	1^{34}	8	.....	.....
1006	4	.....	2	1	.....	1	.....	.....	.....	.....	.....	A	E	1	2	1	.....	.....	1	.....	42	.....	20^{51}	9	2^{51}	5^{87}	N	.....	.....	4	.....	4	.....	.....	.....	43	.....	35^{88}	5	3	.....
1041	1	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	A	—	—	3	.....	2	.....	1^{59}	.....	.....	.....	.....	.....	.....	.....	†T	†T	.....	3	.....	3^{80}	.....	.....	.....	14	.....	6	7^{91}	1	.....
1561b	4	.....	.....	3	1	.....	.....	.....	.....	.....	.....	A	Ne	M	10	3	1	1	3	2^{92}	34	3	20	7	3	1	N	.....	.....	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1745a	3	1	.....	1	1	.....	.....	.....	.....	.....	.....	A	.....	—	.....	.....	2	.....	.....	.....	27	.....	22	2	2^{93}	1	†ca	A	ch	.....	4	.....	.....	1	.....	24	4	13	1	2	4^{94}
2193	5	1	.....	3	2	.....	.....	.....	.....	.....	.....	ASx	—	—	2	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	N, cr	A	rh	3	.....	.....	.....	.....	1^{95}	27	7	16	1	.....	.....
2431	4	.....	.....	3	1	.....	.....	.....	.....	.....	.....	A	A	†dy	3	.....	.....	2	.....	1^{95}	8	.....	.....	8	.....	.....	N	A	—	6	.....	1	4	1	.....	10	.....	6	2	.....	2^{97}
2892	10	1	.....	8	1	.....	.....	.....	.....	.....	.....	A	A	—	5	1	2^{23}	.....	2^{23}	.....	3	.....	.....	3	.....	.....	N	—	—	6	2	.....	2	2	.....	10	.....	.....	10	.....	.....
3274	9	4	.....	1	1	2^{96}	1	.....	.....	.....	.....	A	—	—	3	.....	2	.....	1	.....	13	.....	13	.....	.....	.....	†cb	—	—	2	.....	1^{105}	.....	2^{101}	.....	10	.....	9	.....	1^{102}	.....
3391	4	1	1	.....	.....	2	.....	.....	.....	.....	.....	ANe	A	—	3	.....	1	1	3^{102}	.....	11	.....	8	.....	3	.....	N	†ca	—	3	1	.....	.....	.....	.....	6	2	4	.....	.....	.....
3752	7	4	1	2	.....	.....	.....	.....	.....	.....	.....	A	—	—	4	2	2	.....	.....	.....	1	.....	.....	1	.....	.....	†T	—	—	2	1	1	.....	.....	.....	1	.....	1	.....	.....	.....
3771	12	5	.....	4	2	.....	1	.....	.....	.....	.....	A	—	†en	6	1	.....	4	1	.....	22	2	5	15	.....	.....	N	bd	M	6	1	2	2	1^{102}	.....	11	2	1	8	.....	.....
3846	10	2	.....	5	1	.....	.....	2^{108}	.....	.....	.....	A^{108}	—	—	6	.....	4	1	.....	1^{107}	20	2	8	10	.....	N	.....	.....	.....	.....	.....	.....	.....	.....	.....	9	1	8^{108}	.....	.....	.....
4262	5	1	2	1	1	.....	.....	.....	.....	.....	.....	A	.....	—	2	.....	.....	2	1^{109}	.....	8	.....	6	.....	2^{109}	N	.....	.....	.....	7	.....	7	.....	.....	.....	17	.....	17	.....	.....	.....
4371	5	1	1	.....	2	1	.....	.....	.....	.....	.....	A	.....	—	1	.....	.....	1	.....	.....	74	8	34	28	1^{110}	3^{111}	—^{112}	†ca	†T	1	.....	1	.....	.....	.....	10	.....	7	2	.....	1^{113}
4475a	5	.....	.....	.....	1	.....	.....	.....	3	.....	.....	A	†T	1	2	.....	1	.....	1^{114}	.....	14	.....	12	.....	.....	.....	†ca	—	—	4	1	.....	3^{116}	.....	.....	20	.....	18	1	1	1^{118}
4552	10	5	2	.....	2	1	.....	.....	.....	.....	.....	A	.....	.....	3	.....	2	.....	1^{117}	.....	14	.....	.....	.....	.....	.....	N	.....	.....	7	.....	6	.....	1^{115}	.....	7	.....	7	.....	.....	.....

[1]D. [2]ap. [3]sb. [4]T. [5]rh. [6]P. [7]E, 1F. [8]criminalistic. [9]1 cr. [10]A. [11]E. [12]rh[13]ca, [14]obs, [15]T, 1A. [16]Ne. [17]D. [18]2A, 1M, 2Ne. [19]E. [20]abd, 1sm. [21]M, 1Nc. [22]sh. [23]sd. [24]vertigo. [25]E, [26]1E, 1I. [27]ca. [28]T, [29]ch. [30]F. [31]P. [32]all[33]T. [34]F, [35]1E, 1F. [36]T. [37]am. [38]attempted suicide. [39]1 disappeared. [40]2A. [41]dt. [42]1E, 3F. [43]3I, 1su. [44]D. [45]1ca. [46]4B. [47]unstable. [48]P. [49]E. [50]I. [51]F. [52]A. [53]F, [54]D. [55]P. [56]F. [57]3E, 1F, 2I. [58]also rh. and la. [59]A. [60]1I, 2E. [61]A. [62]7E, 1F. [63]2A, Ne. [64]2 † cancer. [65]2bd. [66]1ca. [67]B. [68]4dy. [69]3bd. [70]1ca. [71]B. [72]P. [73]2E, 1F. [74]E. [75]2E, 1F, 1I. [76]2B, 1D, 2ca. [77]E. [78]2I in Soldier's Home. [79]1rh. [80]2E, 1F. [81]A, 1†P. [82]all[83]I, 1I. [84]F. [85]2ca. [86]A. [87]4dfm. [88]A. [89]C. [90]A. [91]A. [92]ca. [93]sd. [94]1ap, 1dy. [95]A. [96]A. [97]1ca. [98]1ap at birth of E child. [99]F. [100]1ap. [101]A, 1Ne. [102]E. [103]M. [104]A.

in the fraternities all normal parents must belong to defective strains. In twenty-six of the families something is known concerning more than two relatives of the normal parent. Two other fraternities are included because they have known defect (Table C). Of these 28 families of normal parents of epileptic children

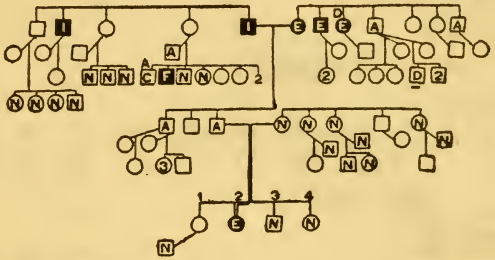

FIG. 28. The central mating is between a normal woman (one of whose sisters has a neurotic child) and an alcoholic man of a frightfully bad strain. He deserted his wife and children. His eldest brother (the only one who grew up) was also a sot. Their father was insane (melancholic ?) and committed suicide and had an insane brother and a feeble-minded nephew, and their mother was one of three epileptic sibs and belonged to a deaf-mute strain. Despite the bad protoplasm of the father's side, in the central mating the strong germ cells of the mother result in two normal children, but the first child is neurotic and the second an epileptic at State Village. Case 1006.

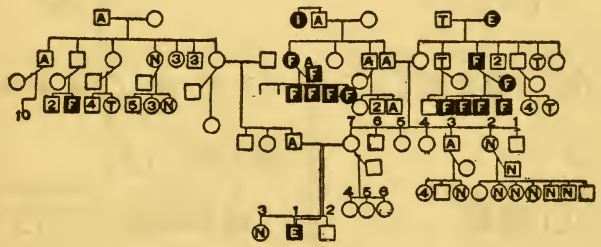

FIG. 29. This chart illustrates many principles. The central mating is that of a normal × alcoholic with one of the children normal; the other defective. There are in one branch of this family two F × F mating with eight feeble-minded children and none normal; and in the midst of this branch of the family (lower, right) is an N × N mating with five normal offspring and one (the eldest) neurotic. Case 1745.

every one shows evidence of mental weakness. In nineteen of these at least one relative is either epileptic, imbecile or insane; in five others there is migraine or other form of neurosis; in two others there have been two relatives each with paralysis; in one of the remaining two families there is an alcoholic relative and in the other one alcoholic and one criminalistic. It would seem to

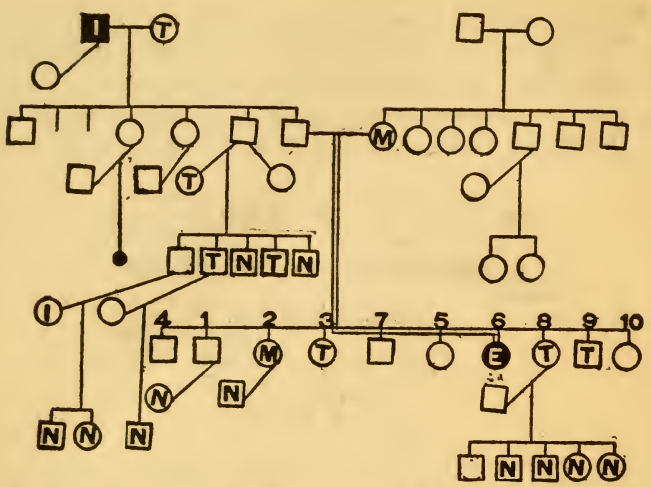

FIG. 30. The central mating is between a migrainous woman and a man who was himself, so far as known, normal but whose father showed senile dementia and whose brother was affected with vertigo. There were ten children, of whom Nos. 5, 7 and 10 died early; and little is known about No. 1. No. 4 is neurotic, No. 2 migrainous and No. 6 is epileptic and at State Village. The other three children are tubercular, two already dead before attaining the age of twenty years. Case 1149.

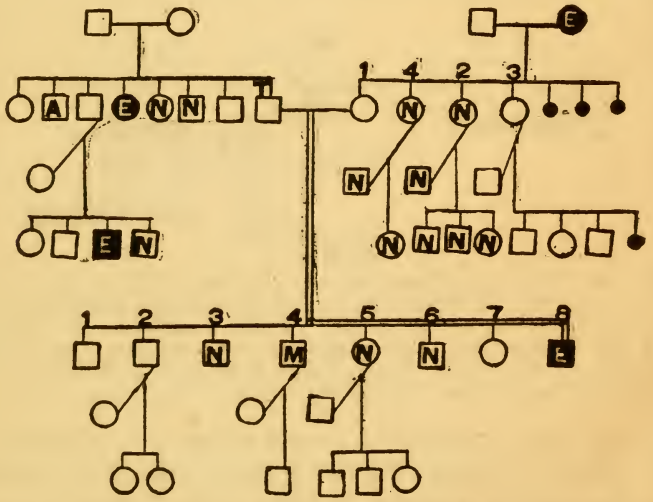

FIG. 31. Here a neurotic woman, whose mother was epileptic, marries a mentally normal but tubercular man who had an epileptic sister and nephew. Of the eight children No. 1 died at seven years, No. 2 shows defective speech, No. 4 migraine, No. 7 St. Vitus' dance, and No. 8 is an epileptic at State Village. Three children are nervously strong. Case 2673.

TABLE VII.

THE FREQUENCY OF THE DIFFERENT CLASSES OF MENTAL CONDITION IN THE CHILDREN OF PARENTS BOTH OF WHOM ARE MENTALLY NORMAL BUT HAVE PRODUCED ONE OR MORE EPILEPTICS; TOGETHER WITH THE MENTAL CONDITION OF THE GRANDPARENTS, THE PARENTS' SIBS AND OTHER BLOOD RELATIVES ABOUT WHOM SOMETHING IS KNOWN.

Abbreviations.—A, alcoholic; ap, apoplexy; B, blind; bd, affected with Bright's disease; C, criminalistic; ca, cancerous; cb, childbirth; ch, choreic; cr, cripple; D, deaf; dau, daughter; dfm, deformed; dp, dementia præcox; dt, delirium tremens; dw, dwarf; dy, dropsical; E, epileptic; ec, eccentric; en, encephalitis; F, feebleminded; f, father; ff, father's father; fm, father's mother; go, göitre; gp, general paralysis of the insane; ht, heart disease; hy, hysteric; I, insane; id, ill defined organic disease; kd, kidney disease; la, locomotor ataxia; M, migrainous; m, mother; md, manic depressive insanity; mf, mother's father; mm, mother's mother; N, normal; Ne, neurotic; np, neuropathic; obs, obesity; P, paralytic; pa, paranoiac; pn, pneumonia; S, syphilitic; sb, softening of the brain; sco, scoliosis; sd, senile dementia; sh, shiftless; sm, simple meningitis; st, stillborn; su, suicide; Sx, unchaste; T, tuberculosis; tf, typhoid fever; tu, tumor; va, varicose veins; ve, vertigo; W, vagrant; x, unknown; ? implies doubt; † died.

Ser. No.	Children. Total.	† early.	x	N	E	F	I	Ne	A	P	f	ff	fm	f's sibs. Total.	† early.	x	N	Ne	np	Other f's relatives. Total.	† early.	x	N	Ne	np	m	mf	mm	m's sibs. Total.	† early.	x	N	Ne	np	Other m's relatives. Total.	† early.	x	N	Ne	np
1941a	2	.....	...	1	I	.....	.....	.....	.....	.....	N	?	†P	4	.....	3	...	I[1]	...	11	.....	9	.....	...	2[2]	N	?	?	10	.....	3	7	.....	...	18	.....	7	10	...	I[3]
643b	10	.....	3	5	2	.....	.....	.....	.....	.....	?N	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	?N	?	?[2]	10	.....	4	6	.....	.....	16	.....	6	8	I[4]	I[5]
914	8	.....	2	5	I	.....	.....	.....	.....	.....	N	—	—	3	.....	3	.....	.....	.....	6	.....	4	2	.....	.....	N	—	—	4	.....	3	I[6]	.....	.....	I	.....	I	.....	.....	.....
936	5	.....	I	2	I	.....	I	.....	.....	.....	N	—	—	2	.....	.....	I[2]	.....	.....	9	.....	8	.....	I[7]	N	?N[8]	N[8]	I	.....	I	.....	.....	.....	30	.....	20[10]	.....	I[7]
1115	10	.....	4[11]	5	I	.....	.....	.....	.....	.....	N	—	—	I	.....	.....	I	.....	.....	.....	.....	.....	.....	.....	.....	N	—	—	0	.....	.....	.....	.....	.....	11	.....	8	2	...	I[12]
1261a	14	4	...	8	I	.....	.....	.....	.....	.....	?N	—	—	I	.....	.....	.....	I[13]	.....	.....	.....	.....	.....	.....	.....	?N	—	—	9	.....	9	.....	.....	.....	.....	.....	.....	.....	.....	.....
1321b	6	2	...	3	I	.....	.....	.....	.....	.....	N	—	—	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	N	N	N	9	.....	.....	9	.....	.....	44	4	30	8	...	2[14]
1350	6	3	I[15]	...	I	.....	.....	I	.....	.....	?N	N	N	6	.....	.....	6	.....	.....	15	7	I	7	.....	.....	?N[15]	—	—	4	.....	4	.....	.....	.....	10	.....	9	.....	.....	I[14]
1445	4	I	I	I	I	.....	.....	.....	.....	.....	?N	—	—	6	.....	5	.....	I[17]	.....	.....	.....	.....	.....	.....	.....	?N	—	—	8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1541a	8	I	...	4	I	.....	.....	I	I	.....	N[18]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	?N	.....	.....	I	.....	I	.....	.....	.....	.....	.....	.....	.....	.....	.....
2233	8	I	...	6	I	.....	.....	.....	.....	.....	N	?	E	8	3	2	2	.....	I[19]	34	10	16[20]	8	.....	N	I[21]	—	—	4	I	...	3	.....	.....	11	.....	8	3	.....	.....
2254	2	.....	.....	I	I	.....	.....	.....	.....	.....	N	—	—	5	2	2	I	.....	.....	6	I	...	5	.....	.....	N	?N	?N	2	.....	.....	2	.....	.....	25	3	12	8	2[22]	.....
2269	14	3	...	9	I	.....	I	.....	.....	.....	N	?[23]	—	3	2	.....	I	.....	.....	9	.....	4	5	.....	.....	N	—	—	9	3	I	5	.....	.....	27	.....	20	6	I[24]	.....
2583	I	.....	.....	I	.....	.....	.....	.....	.....	.....	?N	—	†en	2	.....	2	.....	.....	.....	10	3	6	.....	I	?N	—	†tu	11	6	...	4	I[25]	.....	17	7	10	.....	.....	.....
2627	6	I	...	5	I	.....	.....	.....	2[26]	.....	N	?	tap	3	I	...	2	.....	.....	8	.....	6	I	I[27]	.....	N	—	†[27]	10	4	3	3[28]	.....	.....	33	3	27	3	.....	.....
2685	5	.....	.....	3	I	.....	.....	I	.....	.....	N[29]	—	—	2	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	?N[29]	—	—	4	.....	.....	2	.....	2[25]	.....	.....	.....	.....	.....	.....
2983	7	.....	.....	6	I	.....	.....	.....	.....	.....	N	—	—	5	.....	3	I	I	...	16	.....	15	.....	I[23]	N	N	—	—	4	.....	I	3	.....	.....	22	.....	15	6	...	I[30]
3021	10	3	2	4	I	.....	.....	.....	.....	.....	N[31]	—	—	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	N	—	—	3	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	.....
3189b	3	.....	.....	2	...	I	.....	.....	.....	.....	N	A	FA	7	5	...	...	.....	2[32]	.....	.....	.....	.....	.....	.....	N	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3395	2	.....	.....	I	.....	.....	.....	.....	.....	.....	N[33]	—	—	7	I	2	2	2[27]	...	24	.....	22	2	.....	.....	N	N	N	8	5	...	3	.....	.....	64	2	42	9	7[34]	4[35]
4096b	4	I	...	2	I	.....	.....	.....	.....	.....	N	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	N	N	M	11	.....	.....	10	I[36]	.....	.....	.....	.....	.....	.....	.....
4113	3	.....	.....	2	I	.....	.....	.....	.....	.....	N[37]	—	—	10	I	8	I	.....	.....	27	.....	21[38]	5	I[38]	.....	N[39]	N[40]	M	12	3	6	2	I[41]	.....	29	4	22[42]	2	I	.....
4413	7	I	...	5	I	.....	.....	.....	.....	.....	N	—	—	11	8	2	.....	.....	.....	I[43]	.....	.....	.....	.....	.....	N	A	—	3	I	2	.....	.....	.....	53	.....	52	.....	.....	I[44]
4489	5	.....	.....	4	I	.....	.....	.....	.....	.....	N	—	—	6	.....	I	4	.....	I[45]	26	.....	19	6	I[46]	?N	—	—	7	.....	4[47]	I	.....	I[48]	5	I	3	.....	.....	I[49]

[1]ch. [2]F. [3]Sx. [4]A. [5]E. [6]A. [7]I. [8]tca. [9]kd. [10]†F, isco. [11]clubfoot. [12]E. [13]Sx. [14]E. [15]bd. [16]F. [17]F. [18]T. [19]E. [20]tca. [21]sd. [22]†P [23]tca. [24]su. [25]sm. [26]ch. rhy. [27]A. [28]tbd, tgo. [29]†T. [30]tca. [31]P, [32]F, su, Sx. [33]E. [34]tbd. [35]E. [36]†T. [37]A. [38]6P, tA. [39]3E, IF. [40]E. [41]tca. [42]tca. [43]A. [44]†T. [45]M. [46]4†T. [47]E. [48]I. [49]E. [50]A. [51]3†T. [52]F.

be rare that a person of mentally strong strain, even if mated to a "tainted" person, should have an epileptic child. The normal parent of an epileptic usually has some defective germ cells.

TABLE C.

SHOWING THE DISTRIBUTION OF THE TAINTED RELATIVES OF A NORMAL PARENT OF EPILEPTICS INTO THE VARIOUS CLASSES OF MENTAL CONDITION.

Ser. No.	Tainted parent.	Total known relatives	E	F	I	M and Ne	A	P	Sx	ve	su	ch	C
94	f	6	....	....	....	.....	....	2	...	...	...	...	..
306	m	3	....	....	....	.....	....	2	...	...	...	...	..
1149	f	2	....	....	1	.....	....	....	...	1	...	...	..
1435	f	7	1	....	....	.....	....	1	...	...	...	...	..
194b	m	18	....	1	....	.....	....	....	...	...	...	...	..
145	m	7	2	1	....	.....	....	1	...	...	...	...	..
332	m	15	1	3	....	.....	....	....	...	...	...	...	..
346a	f	8	....	....	4	.....	....	....	...	...	1	...	..
1451	f	5	....	1	1	.....	....	....	...	...	...	...	..
2375	f	4	1	....	....	.....	....	3	...	...	...	...	..
503, 3781	b	68	3	1	2	12	....	....	...	...	...	...	..
314b	m	9	1	1	....	.....	....	2	...	...	...	...	..
1704	m	19	2	....	....	2	....	....	...	...	...	...	..
2557	f	5	....	....	....	.....	1	....	...	...	...	...	..
83	f	6	....	....	1	.....	....	1	...	...	...	...	..
1475	f	12	....	....	....	1	....	1	...	...	...	...	..
483	m	16	....	1	....	1	....	1	...	...	...	...	..
971	m	15	....	....	1	2	....	....	...	...	...	...	..
1006	m	12	....	....	....	3	....	....	...	...	...	...	..
1044	m	9	....	....	....	1	....	....	...	...	...	1	..
1745	m	10	....	4	....	3	1	..	...	...	...	...	..
2193	m	16	....	....	1	3	1	....	...	...	...	...	..
2431	m	10	....	2	....	1	1	....	...	...	...	...	..
2892	m	14	....	....	....	2	....	....	...	...	...	...	1
3274	m	2	....	....	....	.....	1	....	...	...	...	...	..
3772	m	13	....	....	....	1	1	....	...	...	...	...	..
4276	m	6	....	1	....	.....	....	....	...	...	...	...	..
4475a	m	5	1	....	....	4	....	....	...	...	...	...	..

Table VII shows the proportions of the various mental conditions occurring among the offspring of two normal parents *in those families that have epileptic children.* This table is of great theoretical interest. If our hypothesis that ordinary epilepsy is due to the absence of a character is correct then if the normal parents produced all germ cells with the character all offspring should have the character. The fact that some offspring are defective is explained on Mendelian grounds on the assumption that both parents though somatically normal, have one half their germ cells defective. What evidence is there of the application of Mendelian expectation to this case? There are 24 matings

of normal × normal (Figs. 32, 33). If we exclude from consideration all parents of whose relatives nothing is known or who have indeed fewer than 4 relatives of whose health something is known 33 parents remain (including 8 with fewer than 4 known

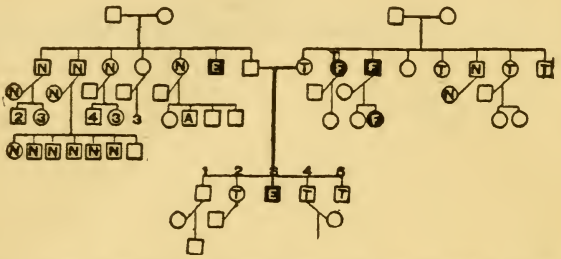

FIG. 32. Two apparently normal parents (each with defective sibs) have five children, of whom one is epileptic. Case 4489.

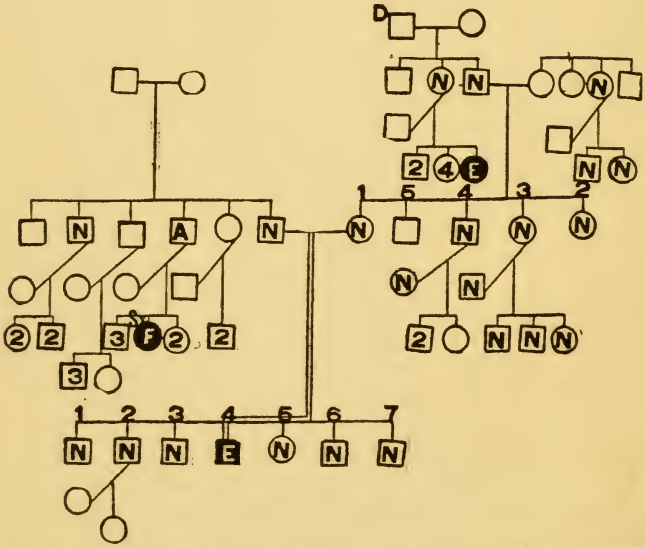

FIG. 33. Two normal parents, father with a feeble-minded niece, mother with an epileptic first cousin, have seven children, of whom all are normal save one epileptic at State Village. Case 2983.

relatives, but with one defective, Table D). Of these 33 parents only three show no weakness of the 10 enumerated classes (epileptic, feeble-minded, insane, migrainous and neurotic, alcoholic, paralytic, sex offending, choreic, suicidal, criminal). Twenty of

the 33 parents have relatives with admitted epilepsy, imbecility or insanity. Of the three excepted parents one has a brother who died at 35 years of meningitis and one has a brother who died of encephalitis and a sister with goitre. Since only two tenths of one per cent. of the population at large is epileptic the fact that

TABLE D.

CLASSIFYING THE DEFECTIVE AND TAINTED RELATIVES OF TWO NORMAL PARENTS WHO HAVE EPILEPTIC CHILDREN.

		Total Known Relatives.	E	F	I	M and Ne	A	P	Sx	ch	su	
194a	F	4	....	2	....	....	....	....	....	1	...	.....
194a	M	18	....	1	....	.....	....	....	....	....	...	.....
643b	M	11	1	....	....	.....	1	....	1	....	...	.....
914	M	6	....	....	....	.....	1	....	....	....	...	.....
936	F	4	....	....	1	.....	....	....	....	....	...	.....
936	M	6	....	....	1	.....	....	....	....	....	...	.....
1115	M	4	1	....	....	.....	....	....	....	....	...	.....
1324	M	20	2	....	....	.....	....	....	....	....	...	.....
1356	F	16	....	....	....	.....	....	....	....	....	...	all N
1356	M	1	....	1	....	.....	....	....	....	....	...	.....
1445	F	2	....	1	....	.....	....	....	....	....	...	.....
2232	F	6	2	....	....	.....	....	....	....	....	...	.....
2232	M	7	....	....	1	.....	....	....	....	....	...	.....
2254	F	8	....	....	....	1	....	....	....	....	...	.....
2254	M	14	....	....	....	.....	....	1	....	....	...	.....
2269	M	12	....	....	....	....	....	....	....	....	1	.....
2583	F	3	....	....	....	1 ..	....	....	....	....	...	.....
2583	M	5	....	....	....	.....	....	....	....	....	...	1†sm
2627	F	1	....	....	....	.....	1	....	....	....	...	.....
2627	M	6	....	....	....	.....	....	....	....	....	...	1†enc.
2685	M	2	....	....	....	.....	....	2	....	....	...	.....
2984	F	3	....	1	....	.....	....	....	....	....	...	.....
2984	M	10	1	....	....	.....	....	....	....	....	...	.....
3182	F	4	2	1	....	.....	....	....	....	....	...	.....
3296	F	6	....	....	....	.....	2	....	....	....	...	.....
3296	M	14	3	1	....	.....	1	6	....	....	...	.....
4096	M	11	1	....	....	.....	....	....	....	....	...	.....
4113	F	7	....	....	....	.....	1	....	....	....	...	.....
4113	M	6	....	....	....	2	....	....	....	....	...	.....
4413	F	1	1	....	....	.....	....	....	....	....	...	.....
4413	M	1	....	....	1	.....	....	....	....	....	...	.....
4489	F	12	1	....	....	.....	1	....	....	....	...	.....
4489	M	4	....	3	....	.....	....	....	....	....	...	.....
335 parents	....	235	15	11	4	4	8	9	1	1	1	.....

1.5 per cent. of the known relatives of the normal parents of epileptics are epileptic shows that these normal parents do not belong to normal strains. All facts speak for the conclusion that, possibly with the exception of the father of case 1356, all parents of epileptics in Table D belong to neuropathic strains; and warrant

the hypothesis that, apart possibly from traumatic causes, epilepsy rarely, if ever, arises from strains devoid of defective germ plasm.

Does epilepsy ever arise in a stock devoid of neuropathic taint? It is generally held that epilepsy is a "complex"; that its causes are varied; that its forms are diverse. The most progressive students of epilepsy might even maintain that there is just as much difference between one form of "epilepsy" and another as between "cancer" and a boil. However useful such an analysis may be for some purposes it appears that for the question of inheritance of the great majority of cases that get into an institution it has little importance. The various common types of epilepsy behave as though they were alike in lacking some element necessary for complete mental development; and they behave alike when mated with normal individuals with defect "in the blood." A "defective" protoplasm (of whatever origin and however it is to be interpreted) acts like the absence of something, and the various forms of defect are, within limits, mutually replaceable. For practical purposes a "neuropathic taint" may be recognized as though it were an inheritable unit.

But how about traumatic epilepsy? Is that inherited like other forms? More recent experiments have not confirmed the results of Brown-Séquard who asserted the inheritance of acquired epilepsy in guinea pigs. Do our pedigrees reveal any case of non-inheritable epilepsy or other evidence that epilepsy may occur in a stock devoid of neuropathic taint? We can only say that, in the limited material at our disposal, there is no epileptic parent that transmits like a normal; and only one case of an epileptic child from a family (of significant size) that shows no evidence of a neuropathic taint. This does not question the fact of traumatic epilepsy. It merely indicates its relative infrequency.

Finally, the social bearing of the facts of inheritance of epilepsy must be considered.

First. Is there evidence that alcoholism is a cause of epilepsy and other defectiveness? There is no doubt about its association with defectiveness; the doubt is whether alcoholism may not be a symptom—evidence of such a mental weakness as cannot resist the temptation of alcohol. A criterion may be found in the outcome of such matings as we have tabulated. If alcoholism is merely a symptom like chorea and if it is evidence of a simplex mental condition, then results of matings should show, undis-

turbed, the expected proportions; but if, on the other hand, alcoholism is a cause of defective offspring then the proportion of defective offspring should exceed expectation. We do not pretend to have sufficient data, and data of the right sort, to settle this question; but what we have is sufficient to give some support to one hypothesis or the other. In Table II we find a great preponderance of defective offspring—87 per cent., instead of the expected 50 per cent. In Table V the matings of alcoholics with other "tainted" consorts yield 23 defectives in 71, or 32 per cent. instead of 25 per cent. The two fraternities from two alcoholic parents give, together, 25 per cent. epileptic and the same of neurotic offspring. In the alcoholic × normal matings of Table VI, where only 25 per cent. defectives are to be expected, actually 29 out of 80, or 36 per cent. are defective. We see, accordingly, a constant excess beyond expectation of epileptic and feeble-minded offspring from alcoholic parents. In so far our results support the view that alcoholism, to a certain extent, is a cause of defect; that 10 or 20 per cent. more children in any fraternity are defective than would be were it not for alcohol. However, a word of caution must be added. It is not improbable that some of the alcoholics are actually feeble-minded and any such would tend to increase the average of defective offspring because of their inherent defective germ cells and quite apart from any poisoning effect on the germ cells of alcohol. The hypothesis that alcohol is a "race poison" deserves more critical, especially experimental, study on the lower animals.

Second. Have we any reason for believing in an increase in the proportion of epilepsy to the population at large? Certainly the care of epileptics is an increasing burden to the state; but it is obvious that that is largely because the class is better cared for by the state.

To answer the question completely for any state like New Jersey we should find the proportion of epileptics in the population born between 1870 and 1900 and compare it with the proportion of epileptics in the population born between 1840 and 1870. No census adequate to give these proportions has been made. An approximation to the required comparison would be furnished if we had a *random* sample of the population of each of the two epochs and knew the proportion of epileptics in each sample; but we cannot, as yet, meet that condition. The best thing we can

do is to compare the proportion of epileptics in a collection of families in the latest generation (selected in nearly all cases because they have at least one epileptic in the fraternity) with their paternal and maternal fraternities (selected insofar as parents, uncles and aunts of an epileptic fraternity usually comprise at least one epileptic). The required result is easily got from the tables. It appears that of 1,020 persons belonging to the parental generation 124 or 12.2 per cent. are epileptic or imbecile; while of the 739 persons in the following or filial generation 270 or 36.5 per cent. are epileptic or imbecile. It might be concluded, in other words, that, given an ancestry such as is producing defectives, it tends to produce offspring with three times the proportion of defectives that it has itself. Such a conclusion would be unwarranted. For in the same generation with the affected fraternity are other fraternities of cousins none of whom contain defective children; it is certain that if these unaffected fraternities were included they would much reduce the proportion of defectives in the younger generation. We have calculated the proportion of epileptic and imbecile children to all children in the later generation and compared it with the ratio of the generation to which the parents belong. In the earlier generation the relation is 159 defectives out of 1,354 children; in the later generation, 366 out of 1,460. Or the ratios are, respectively, 11.7 per cent. and 25.1 per cent. That is, the proportion of defectives in the younger generation is more than double that of the earlier. Making a slight allowance for the possibility that the defects of some of the parental generation have been concealed (and this, on account of the inaccessibility of the parental generation the field worker can not always check) it is probable that the proportion of defectives in the population we are studying doubles in each generation and is now 1 in each fraternity of 4! Were the population to mate in the future about as in the past it is easy to see that, in half a century, on the average over half of each fraternity of the epileptic-producing population would be defective.

Of course, the families constitute a small, selected portion of the population of New Jersey. Probably the total number of persons now living in New Jersey whose mental condition is adequately described in our data is not over 2,500 or 1 to 1,000 of the total population of the state. Our strains, then, constitute an unimportant part of the population. Is there any reason to sup-

pose that the families of such strains as we have studied are increasing faster than the population at large? We do not know the average size of fraternities in New Jersey. The census determination of "size of private family" is 4.4 for the state, which would allow for 2 parents and 2.4 children; but this gives a very imperfect idea of the size of fraternities, because only children at home are considered in the family, incomplete fraternities are averaged with those fully finished, and there are other objections that will readily occur to anyone. We would perhaps do better to compare the size of our fraternities with those of a high social status like those of Harvard graduates which average slightly less than two children. For the better educated, more effective, and mentally most advanced part of our eastern population the average number of children of a pair of parents is probably between three and four. What is it in our special population? A count was made of 108 fraternities taken at random—the first 108 in the series fulfilling the following conditions: The members of the fraternity were born (as far as it was possible to select them) between 1860 and 1900, ensuring the completion of the family and at the same time bringing the families as close as possible to the present. However, as was inevitable, some of the families belong to an earlier decade (of the seventies or eighties), when the number of children in a family was larger than now. The average size of the fraternities counted is close to 5, and the average number of the members surviving to maturity was about four. All in all, the result indicates that the fraternities in the strains to which epileptics belong are not very different in size from those of the population at large. Even in the matings of two feeble-minded persons the average number of offspring of a single mating is only 4.4, but the total fecundity of the mothers averages slightly higher than that.

All fraternities with feeble-minded mothers yield an average of 6 (6.05) children born. The average fecundity of the mothers is (on account of double matings) somewhat greater than this. All fraternities with epileptic mothers yield an average of 6 (6.04) children born. We have calculated the average number of children born to families with "normal" mothers as taken from the tables. These are not always the latest complete generation but this is usually the case. Here we get again the figure 6 (6.06). There is thus a surprising agreement in the size of fraternities

derived from the epileptic, feeble-minded and normal mothers of our families. The greater size of these principal fraternities (i. e., containing the patient whose pedigree is being investigated) as compared with the collateral fraternities, that gave an average size of 5, is probably due to the fact that the principal fraternity is more fully known; in the collateral fraternities some children have not been recorded.

The upshot of these counts is that they afford no evidence that the families containing defectives are exceptionally large, any larger than other families. It is probable that the increase in such families is nearly the same as the population in general.

It appears then that, while as matings are at present made epilepsy tends in successive generations to form a larger part of the population, this process has not, until recently at any rate, been furthered by a relative increase in the number of individuals belonging to the defective strains—but by a higher incidence—a greater density—of defect inside such strains. If our data should hold generally for strains with epileptic members we could conclude that, if no change in mating and fecundity occur, the number of epileptics and feeble-minded in the state of New Jersey will be relatively double what it is now in 1940, and relatively four times as common in 1970. Thus if the present proportion is 1 to 500 it would be 1 to 125 in 1970.

What measures are recommended to stop this increase? The most effective, violating least the social ideals of our time, is the segregation during the entire reproductive period—(say from 15 to 45 years of age) of epileptics of both sexes. Such measures would be an expensive burden for the present generation of taxpayers; but if it is ever justifiable to bond a state it is for such a purpose as this; because inside of ten years the stream of defective children would be almost dry. By twenty years half of the temporary detention-sanatoria for defectives could be closed, and by thirty years the expense of maintenance would probably be less than it is now. By forty years an institution like that at Skillman would probably provide ample accommodation for all the remaining defectives (now grown quite gray) and in fifty years there would remain only an old man's and old women's home for such as did not care to leave its shelter to return to their relatives. By this time the State could pay off its bonds from the sale of most of the land reserved for these unfortunates. Of course,

through immigration, through trauma, and through the chance union of defective germ cells of normal persons a thin stream would be maintained, but the State would have control of the situation and the expense would be ever diminishing instead, as now, ever increasing.

SUMMARY

1. The method of field-study of epileptic families combined with the modern biological methods of analysis of hereditary data constitute a vastly improved means of inquiry into inheritance of epilepsy.

2. Epilepsy and feeble-mindedness show a great similarity of behavior in heredity supporting the hypothesis that each is due to the absence of a protoplasmic factor that determines complete nervous development.

3. When both parents are either epileptic or feeble-minded all their offspring are so likewise.

4. The conditions named migraine, chorea, paralysis, and extreme nervousness behave as though due to a simplex condition of the protoplasmic factor that conditions complete nervous development; i. e., persons belonging to these classes usually carry some wholly defective germ cells. Such persons may be called "tainted."

5. When such a tainted individual is mated to a defective about one half of the offspring are defective.

6. When a simplex normal is mated with a defective about half the offspring are normal; the others defective or neurotic.

7. When both parents are simplex in nervous development and "tainted" about one quarter (actually 30 per cent.) are defective.

8. The proportion of tainted offspring is not noticeably higher when both parents show the same nervous defect.

9. Normal parents that have epileptic offspring usually show gross nervous defect in their close relatives.

10. While we recognize that "epilepsy" is a complex, yet there is a classical type numerically so preponderant that, in the mass, "epilepsy" acts like a unit defect.

11. Our data point to a poisoning in slight degree of germ cells by alcohol, but the evidence is hardly crucial.

12. There is evidence that in epileptic strains the proportion

of epileptic children in the latest complete generation is double that of the preceding; but there is no evidence that in these epileptic strains the average number of children in a fraternity is greater than in the population at large. Provided marriage matings continue as at present and no additional restraint is imposed the proportion of epileptics in New Jersey would double every thirty years.

13. The most effective mode of preventing the increase of epileptics that society would probably countenance is the segregation during the reproductive period of all epileptics.

American Breeders' Association — Eugenics Section

DAVID STARR JORDAN, Chairman. C. B. DAVENPORT, Secretary

The Eugenics Record Office

Cold Spring Harbor, Long Island, N. Y.

ESTABLISHED in October, 1910, this office aims to fill the need of a clearing house for data concerning "blood lines" and family traits in America. It is accumulating and studying records of mental and physical characteristics of human families to the end that people may be better advised as to fit and unfit matings. It issues blank schedules (sent on application) for the use of those who wish to preserve a record of their family histories.

The Eugenics Section and its Record Office are a development from the former committee on Eugenics, comprising well-known students of heredity and humanists; among others Alexander Graham Bell, Washington, D. C.; Luther Burbank, Santa Rosa, Cal.; W. E. Castle, Harvard University; C. R. Henderson, University of Chicago; Adolf Meyer, Johns Hopkins University; J. Arthur Thomson, University of Aberdeen; H. J. Webber, Cornell University; Frederick A. Woods, Harvard Medical School. The work of the Record Office is aided by the advice of a number of technical committees. Its superintendent is H. H. Laughlin, Cold Spring Harbor, N. Y., to whom correspondence should be addressed.

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