growth, as in the case cited by Dr. Mills, had actually burst through the dural capsule of the gland and extended up into the interpeduncular region, as illustrated by some of the photographs shown in connection with the presentation of the paper.

Dr. Cushing stated further that he had purposely avoided saying anything in particular about the operative procedure which he has chosen to follow. It is largely a question of one's familiarity with the method which he has most often practised; but Dr. Cushing said that he thought in the majority of the conditions the operation resolved itself into one of two comparatively simple measures—either a transphenoidal operation by the submucous method of approach, which he has described, with removal of the sellar floor and more or less evacuation of the sellar contents, provided the sella turcica has been greatly distended; or, on the other hand, a simple subtemporal decompression in case the growth has evidently burst through the pituitary fossa, or actually started as a suprasellar lesion. As a rule the duration of the patient's hospital residence subsequent to one of these operations is comparatively short—usually from seven to fourteen days.

In Dr. Cushing's series of 104 patients there have been 75 surgically treated cases. Forty-six of these 75 patients have had a transphenoidal operation, 6 of them a second operation, and 3 a third operation. Twenty-two patients have had a simple subtemporal decompression, and 7 have had a transphenoidal operation with subsequent subjection to a subtemporal decompression. There consequently have been 93 operations, and out of this number there have been 9 fatalities—about 10 per cent.—most of them early in the series and in patients with a lesion too far advanced to justify intervention—conditions which are sufficiently well understood at present so that such futile surgical measures would not be undertaken to-day.

The young man to whom Dr. Mills referred at great length had glandular symptoms antedating his period of puberty, and he is now some 38 years of age. A simple transphenoidal operation at a time before his uncinate seizures began would in all likelihood have prevented the invasion of the cranial chamber by the slowly enlarging struma.

Dr. Cushing said, furthermore, that he believed the approach to the gland first advocated by Hartly and subsequently by Krause, and to which attention has again been called by Frazier, is not only a measure which would fail to disclose the lesion in the more favorable surgical cases—namely those in which the growth actually occupies the enlarged sella turcica—but that it could hardly be of permanent benefit either to the cases in which there is an interpeduncular cystic congenital tumor or in those in which a glandular struma has actually burst from the capsule and invaded the cranial chamber; and that though in Dr. Frazier's skillful hands it is a measure which might be justifiable, it is unquestionably one which few would venture to seriously advocate for the general run of these cases.

HUNTINGTON'S CHOREA: A STUDY IN HEREDITY

By Smith Ely Jelliffe, M.D., Elizabeth B. Muncey, M.D., and C. B. Davenport, M.D.

Some ten to twelve years ago Dr. Jelliffe began to collect data relative to the hereditary history of Huntington's chorea in the United States.

In 1908 in the special Huntington number of Dr. Browning's Neurographs he made a preliminary report upon the material collected to that time. This material was restricted to the socalled early families.

In the preliminary paper under discussion he referred to Sinkler's and King's suggestion that many of the early reported cases were of closely related ancestry and that if the complete ancestral history could be obtained all of the cases might be traced back to a restricted focus or series of foci. He was enabled at that time to show that this was partly so and was able to gather, from the early literature and the material then in his possession, enough evidence to make three or four provisional groups, which were called the Long Island, Bedford and Wyoming groups, as reported by Huntington, Waters, Lyon and Gorman respectively. A Massachusetts group was also suggested. It also seemed possible to assert that Huntington's chorea showed Mendelian dominance in heredity.

Shortly thereafter Dr. Jelliffe was fortunate enough to obtain the interest and coöperation of Dr. C. B. Davenport and an extended hereditary survey was planned. The material was turned over to him and for the past three or four years Dr. Elizabeth Muncey has made a most painstaking research in the field. She has personally visited the localities, interviewed living members of the afflicted families, seen thousands of the individual descendants.

As a consequence they are enabled to report in a purely preliminary way some of the results of this extensive survey, the most extensive of any one disorder that has ever been brought together.

The original groups have been broken up into the representative families and it has developed that the early American material, roughly speaking, has come from about five separate sources. These have received extended study and approximately 9,000 individuals have come under consideration. In this collection there are about 1,000 cases of Huntington's chorea. Only one of these families is represented in the chart presented with 260 individuals with Huntington's chorea.

The analysis of this material has only just begun, and it is impossible to assert just what is going to come out of it. Not only is this material available in this charted form, but a complete record of all of the individuals has been recorded from the standpoint of neurological and psychiatric heredity.

Dr. Davenport said their studies have, in general, confirmed the statement repeatedly made that Huntington's chorea is a trait that does not skip a generation. If any individual is free from the tendency to the disease that individual, if mated with an equally immune person, cannot become the progenitor of offspring with the disease—once the line of descent is free it is always free.

The modern interpretation of this state of affairs is that Huntington's chorea is due to the presence in the germ cell of a determiner that persons who do not belong to the affected strain lack. If the fertilized egg (or zygote) receives this determiner from either side of the house, then in the person who develops from that zygote the trait will develop and, moreover, in half of the germ cells of that person the determiner for Huntington's chorea will occur again. If in any person Huntington's chorea does not develop then that is *prima facie* evidence that that person does not have the determiner for the trait anywhere in his makeup—he does not have it in his germ cells and, hence, cannot transmit it.

The practical application of this rule to eugenics is much diminished in value by the circumstance that the onset of chorea is often late in life,

usually long after the period when mates are selected. As only half of the members of a fraternity are typically affected, each member feels that he may escape and, if he considers the matter at all, runs the chances. It may be that future studies will show a difference in the behavior, even at puberty or shortly after, of those who carry the determiner for chorea and those who do not,—a difference pronounced enough to enable the expert to judge which of a fraternity will probably succumb and which are immune. Such a means of differential diagnosis would be of great eugenical importance and deserves to be diligently sought after. In many cases a marked irritability or lack of control begins to show itself months and even years before the forced movements are noticed. We should look for the germs of such behavior even at puberty.

A careful consideration of the charts reveals certain exceptions to the rule that a generation is not skipped. In the case of a disease whose onset is relatively late in life it is to be expected that the parents shall often die before the age at which the disease is due to develop in them. Certain other cases are due to ignorance of the facts,—to false statements made with the desire to shield parents or close relatives. We are warned, by a very few instances, that illegitimacy may possibly confuse the result. But, after all cases of these kinds have been eliminated, there remains a residuum that can, it seems to them, only be accounted for by the occasional failure of the determiner to develop in the parent of an affected child. Students of breeding recognize the occasional *failure of dominance* as a thing to be considered, a thing yet unexplained, but a fact that does not militate greatly against the general acceptance of the nearly universal law of heredity as set forth.

Every student of heredity is on the lookout for evidences that traits as we know them are composite in their hereditary elements. A rapid survey of the data indicates, first, that the symptoms of chorea are not precisely the same in all family strains. Thus one branch is characterized by the fact that the choreic movements begin in the head; in another in the hands. In one family (Flushing, VIII, 261, 263) one choreic brother has a daughter between 60 and 70 years old who is beginning to show twitchings of the hand at this advanced age. Another choreic brother was first attacked at 60 in his hands; the forced movements have since become general. The mental decay has been rapid. His eldest son was neurotic; another, attacked at 43, has declined mentally, though the movements are not marked. In another son the onset was at 40; began in the hands and the mind is greatly affected.

In another fraternity (8: 286–295) the age of onset is usually about 30 years (much younger than the last); and in their children the same age of onset is the commonest. This branch also deteriorates mentally very profoundly. One of the cousins had Sydenham's chorea and the daughter of another is similarly affected at present.

In another case (7: 131) the choreic mother lived to be 80 years old, which is itself evidence that the symptoms were not very severe. Both of her children that survived had chorea in a very *light* form. This illustrates family differences in the virulence of the disease.

In another branch (7: 168) chorea is associated with various psychopathic types. The choreic father developed at 40 years the motor and mental symptoms coincidently. He soon developed a chronic psychosis. Of his nine children two died early, two were choreic, two feebleminded and one epileptic. One of the choreic sons had four children, of whom only one grew up and she had a psychosis and has four descendants, all

peculiar and neurotic. The epileptic son of the original sire died at 42 years before chorea had shown itself. He had, of three known children, two who were choreic and one who had a psychosis.

The foregoing fragments illustrate not only the diversity of symptoms in different branches of the family but also show the occurrence of Sydenham's chorea without deterioration; the occurrence of mental deterioration without forced movements; and the great range of variation in the age of incidence which ranges, indeed, from birth to sixty years or older. Now advanced age of onset, forced movements, and mental deterioration are three principal diagnostic characters of the disease and since they prove themselves to be independently inheritable the query is raised, which it is hoped that further inquirers may answer, whether Huntington's chorea may be—not a necessary but only a frequent and, to a certain degree, accidental association of the diagnostic traits.

(To be continued)