

Lay Supplement No. 5

ALCOHOL, HEREDITY  
AND GERM DAMAGE

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## ALCOHOL, HEREDITY AND GERM DAMAGE

THIS Supplement deals with two of the most fundamental questions concerning the use of alcohol. They are the two upon which there is probably more discussion and, at the same time, more misunderstanding than upon any other. They are the questions of germ damage and of the inheritance of alcohol addiction.

The first is an important problem because it concerns the stock of the human race. Does the use of alcohol cause this stock to deteriorate and degenerate? The second is an important problem because it concerns the development of alcoholism and therefore its control. Do the children of alcoholics inherit a craving for alcohol?

Everyone can see the broad social importance of these problems. And everyone can see, too, that they may have deep personal importance. Often the questions are asked: Does the use of alcohol by either or both parents bring about deficiencies and ill health in the children they have? If such deficiencies occur, do they result from occasional intoxication, or only from alcohol addiction and chronic alcoholism? If deficiencies occur, will they be passed on to succeeding generations? If one marries into a family in which there are alcoholics, is it likely that the children will have the craving? Do alcoholics come from families of "bad" heredity, that is, families in which mental disorders, feeble-mindedness and other defects are common?

For matters which touch so deeply on peace of mind, statements should not be made, no matter how good the intentions, unless the full truth is known so far as science has shown it.

In giving here the best answers that science has obtained for these questions, two points are to be kept constantly in mind. Where the answer is "yes" it is important that it be said so emphatically, for the prevention of alcohol addiction and the maintenance of a good stock of the human race are more important than the peace of mind of any one individual. When it is "no" it

should also be stated definitely, for here false belief is harmful, since it can cause much unhappiness. A mother, hearing of the belief that intoxication of the parents will affect the heredity and injure the child, may wrongfully attribute to this every mental and physical deficiency and weakness which her child seems to show; she may blame herself or blame her husband.

### GERM DAMAGE

By germ is meant the egg of the mother or the sperm of the father. The male and female germ cells contain all the elements which make up the hereditary endowment of the child. Any damage to the germ may alter these elements and so affect heredity. The germ cells are well protected in the body and, moreover, if they are injured, instead of becoming abnormal they usually die or cease to develop; only sterility then results. The problem here is: Does alcohol injure the germ cells to just that slight extent which does not cause destruction but which does cause abnormality? The scientific facts indicate that the use of alcohol does not injure the germ cells and that it does not cause hereditary defects or weaknesses in children.

In considering the evidence for this statement, and the belief often expressed to the contrary, one fact must be continually borne in mind. What we are discussing here is the fundamental problem of heredity as it concerns injury to the human egg or sperm—and all heredity lies within these sex elements. The determination of heredity ends at conception. Drunkenness on the part of the father and drunkenness on the part of the mother do not result in the conception of children whose hereditary endowment is more or less abnormal than would be that of children from these two parents if they did not use alcohol. With that fact, heredity ends. And that is the fact to bear in mind.

Injuries which occur to the developing child after conception and injuries which occur to the child after birth do not belong to heredity. No one will deny that a mother who is frequently drunk, whose health is actually injured by excessive use of alcohol, is a poor mother to bear and raise a child. Equally, no one will deny that a father who is a chronic alcoholic is a poor father and makes a home unsuitable for a child. But these facts do not

concern the heredity of the child—the germs from which it was conceived—any more than do poverty, illness, neglect and brutality. They belong to what is called the environment—the surroundings—of the child, and not to its heredity. Unfortunately this important distinction is not always made and many people erroneously speak of heredity when they really mean the home life of the child.

### ACUTE INTOXICATION AND GERM DAMAGE

THE belief that intoxication at the time of procreation might cause damage to the child is so ancient that we find it expressed in the myths of the Greeks. But age does not make a belief correct. The belief regarding the injuries from intoxication at the time of procreation is expressed in the story of Vulcan, the blacksmith of the gods; he was supposed to have been born lame because his father, Jupiter, begot him while he was intoxicated. Many old rites and customs reflect this same view. Thus in Carthage the bridal couple was ritualistically forbidden to drink wine on their wedding night in order that defective children would not be conceived.

This old idea has been put to test by modern science. One step has been to find out whether or not any of the alcohol that was drunk reached the tissues of the reproductive organs. Experiments have shown that it does and that the concentration of alcohol there is approximately the same as in the blood that supplies all tissues of the body. In very severe intoxication, the concentration of alcohol may rise to 0.2, 0.3, or even in rare instances to 0.5 of 1 per cent. Concentrations above the last figure are dangerous to human life.

These facts do not indicate that alcohol does or does not injure the germ cells. They indicate only that, as with all other tissues of the body, alcohol reaches the germ cells. The concentration is, of course, extremely low; so low, in fact, that alcohol of this strength could be put in the eye, or even on raw flesh, without irritation or injury or any painful sensation.

Some scientific investigators have exposed the germ cells of fish, sea urchins, frogs and similar animals to alcohol in various strengths and observed the effects on the development of the

offspring. The choice of germ cells from these creatures is necessary because they can be obtained and watched outside of the animal's body. It was found that an egg fertilized with sperm which had been soaked for several hours in a solution of alcohol as strong as 10 per cent (20 to 40 times as strong as that found in the human blood in severe intoxication with unconsciousness) showed fully normal development. It was only when the sperm was placed directly in 25 per cent alcohol that it was injured and incomplete or imperfect development resulted. Such concentrations cannot exist in the living human body.

In interpreting such experiments, it must be borne in mind that the enormous differences in concentrations of alcohol between the solution used and that which occurs in the human blood far outweigh any possible difference in the "toughness" of the sperm of a frog as compared to that of a man. The frog or fish itself is killed by concentrations of alcohol in its blood which are a small fraction of that which the germ cells will tolerate without injury.

In intoxication so severe as to cause death in man, no injury to the tissues of the body has been found. Intoxication results from the disturbances in the functions of the nervous system caused by alcohol and not from injury to it; death is due to failure of respiration. Germ cells do not have nerves; they do not become intoxicated, and they are injured by alcohol only when it is present in concentrations far higher than those causing death from failure of respiration—concentrations which are strong enough to be "germicidal." Thus, in a sense, the body protects the germ cells; it is sacrificed before they can be injured. There may be exceptions to this rule—when the action of the injuring agent can be directed specifically on the germ cells and immediate flesh and not, as with alcohol, on the whole body. Thus radium emanations allowed to act on the sex glands may injure the germ cells.

The resistance of the germ cell in the body to chemical substance and the toxins of disease is well known—and alcohol does not form an exception. Ether used for anesthesia has nearly the same effect on the body as alcohol—both are anesthetics although alcohol is much weaker. No one would believe that anesthesia given for a surgical operation—even though the intoxication

was much more severe than that of alcohol—would injure the germ cells and cause defective children. And even though conception does not occur under such anesthesia, the fact remains that the male and female germ cells are present in the body for many days during their formation and storage; hence any conception occurring within one or even several weeks after anesthesia would be with germ cells exposed to the anesthetic. The anesthetic has no effect on the heredity of the child—and neither has alcohol.

There are reports of old experiments carried out on dogs and other higher animals which were presumed, at one time, to show effects of acute intoxication on the offspring. But the experiments were poorly designed and they were "uncontrolled," that is, there was no assurance given that the abnormalities in the offspring might not have occurred even when no alcohol was given. No importance can be attached to such unscientific experiments.

And in this same category fall the efforts of those investigators who have tried to gather evidence of the birth of idiots and other types of defective children conceived while the parents were said to have been in a state of acute intoxication. Such spectacular studies do not yield valid evidence; they belong more in the realm of rumor mongering than in the realm of scientific study.

No acceptable evidence has ever been offered to show that acute alcoholic intoxication has any effect whatsoever on the human germ, or any influence in altering heredity, or is the cause of any abnormality in the child. All facts point to the conclusion that the germ cells are far too resistant to be injured by the concentrations of alcohol in the blood which occur in acute intoxication.

## CHRONIC ALCOHOLISM AND GERM DAMAGE

ACUTE intoxication causes no injury to the organs and tissues of the body or to the germ cells; but the daily excessive use of alcohol may, after many years, lead to chronic alcoholism. In chronic alcoholism the body is definitely injured. Is it possible that the germ cell, too, may be subject to injury in chronic alcoholism so that defects from this cause will appear in the child? This is a question to which much study has been given.

It is a question which must be dealt with within the proper limi-

tations which we have already stated. We are dealing only with heredity—the germ cell—and not with the influence of the poor nutrition of an alcoholic mother on her unborn child (that will be discussed in a later Supplement) or the influence of the alcoholic parents on the home life of the child. In many of the studies intended to show damage to the germ cell by chronic alcoholism these limitations have not been maintained.

Damage to the reproductive organs has occurred in animals given very large amounts of alcohol daily for long periods of time. These amounts of alcohol were much greater proportionally than even the heaviest drinker could consume; the animals were kept deeply intoxicated, even unconscious, most of the time. Damage to the reproductive organs has also been observed in human beings who are chronic alcoholics. It does not follow, however, that damage to the organs of reproduction means damage to the germ cells. Similar changes, even without the use of alcohol, may occur from diseases of the liver and from certain infections. It has never been suggested that these disturbances alter the germ cells. Consequently the finding of changes in the reproductive organs cannot be taken as an indication that if an individual thus affected were able to have a child that the child would be injured.

Moreover, as far as human beings are concerned, there is an additional feature to be considered. The changes in the reproductive organs due to chronic alcoholism usually occur after the age of 45. Statistics show that in the United States only 6 per cent of all births occur after the father is 45.

Much of the evidence on the influence of large amounts of alcohol on the breeding habits and offspring of animals is conflicting. Some investigators have found that rats given large amounts of alcohol daily had fewer litters than nonalcoholized rats. Another investigator found no difference in the number of litters although the number in each litter was smaller. One investigator who used 30,000 mice found that the offspring of those given alcohol for several generations showed no more abnormalities than were found in those which were given no alcohol. Still another investigator reported that the chickens hatched from the eggs of hens given alcohol showed an increased vigor.



When one has read all of the many reports on experiments with alcoholized animals, he must come to the conclusion that many of these experiments were badly designed; that in many others the general nutrition and health of the animal were neglected; and that in none could abnormalities of the offspring be definitely ascribed to damage from chronic alcoholism.

The studies made on human beings show results as conflicting as those made on animals. Often, however, in the light of modern knowledge, an explanation for the results can now be given. These studies have been directed toward comparing the families in which one or both parents were chronic alcoholics with those in which neither was an alcoholic, in respect to:

1. The number of children.
2. The number of miscarriages.
3. The infant mortality.
4. The occurrence of disease.
5. The occurrence of feeble-mindedness, epilepsy and mental disorders.

The conclusions reached in many of the older studies on these points cannot be accepted; it is agreed by modern investigators that the statistical procedures used were at fault. Many of the observations can, however, be used and reinterpreted in the light of modern knowledge. In studies made today it is pointed out that comparisons should not be made as between alcoholic and temperate families but between the children of the same parents before and after the parents became alcoholics. Scientifically this principle is correct, but unfortunately it has not given much practical help since, in most instances, it is impossible to determine when drinking in the parents became excessive. We are therefore forced to use information obtained from the comparison of alcoholic and temperate families, a fact which demands great caution in interpretation of the information. Unfortunately this caution is not always exercised and many erroneous and harmful conclusions have been made and widely publicized.

1. *The number of children.* Practically all investigations as to the number of children in alcoholic and temperate families have the same result: the number of children in the alcoholic families is greater. This numerical superiority holds even when the eco-

conomic status and social level of the families are the same. Table 1 gives the results from a few of the many studies on this feature. As seen, the alcoholic families represented here had approximately a third more children than the temperate families. This result is the opposite of that found in experiments on animals.

TABLE 1  
*Comparison of Average Number of Children in Alcoholic  
and Temperate Families\**

Country	Alcoholic Families		Temperate Families	
	Number of families	Average number of children per family	Number of families	Average number of children per family
United States	145	2.4	150	1.5
Finland	2,461	3.9	1,551	2.4
Sweden†	Over 1,000	5.6	Over 1,000	4.9
France	81	4.5	245	3.2

No one could draw the conclusion that excessive use of alcohol, on the one hand, injured the reproductive functions of animals and, on the other, improved those of man, or that alcohol addicts are more fertile than moderate drinkers or abstainers. No profound explanation is required. The number of offspring that rats and mice have always approaches the maximum possible and this maximum is influenced by the nutritional state of the parents. The excessive amounts of alcohol given interfered with the animal's nutrition. Human beings usually exercise some discretion in the number of children; the larger number in the families of alcoholics reflects only neglect of responsibilities.

2. *The number of miscarriages.* Studies have shown that in alcoholic families the mothers have more miscarriages than in temperate families. This has sometimes been erroneously interpreted as an indication of damage to the germ cells. The true explanation is to be found in the simple fact that, in general, the number of

\*Since the number of children per family varies from country to country, and within a country according to time, economic levels and other factors, the number of children in alcoholic families must be compared with temperate families of the same country, same period and same economic level.

†Exact figures not known.

miscarriages increases as the number of conceptions increases. As Table 1 shows, there are more conceptions and more children in the alcoholic families and therefore more miscarriages.

3. *The infant mortality.* In Table 2 is given the percentage of children of alcoholic and temperate families dying before their fifth year. Attention is called to the note which goes with this table stating the limitations which must be observed in making such comparisons. But even with these limitations it is clear that the mortality of the children in alcoholic families is much higher than in temperate families, in fact, nearly twice as high. This occurrence has been taken, but erroneously as will be shown, as the best possible evidence of germ damage by alcohol; it has been presumed that because of germ damage the children were weakened and because of their weakness had less chance to survive. In reality they had less chance to survive, not because of defects in the germ, but because of the environment into which they were born. Because of the irresponsible and irregular habits of their parents they were neglected.

TABLE 2  
*Comparison of Child Mortality in Alcoholic  
and Temperate Families\**

Country	Alcoholic Families		Temperate Families	
	Number of children	Children dead before 5th year, per cent	Number of children	Children dead before 5th year, per cent
France	363	45.4	791	25.4
Finland	9,640	32.0	3,695	13.5
England	125	55.2	138	23.9
Austria	654	17.6	359	9.7

\*Since the mortality rate for children varies greatly from country to country, and within a country according to economic levels, time and other factors, comparison of child mortality in alcoholic families must be made with temperate families of the same country, for the same period and for the same economic level. To illustrate geographic differences for a given year: In 1935 the infant mortality (under 1 year) was 25.1 per cent in Chile, but only 4.0 per cent in Australia. To illustrate changes in time: The infant mortality rate in the United States in 1915 was 10.0 per cent; but in 1938, only 5.1 per cent.

An illustration of the influence of care on the rate of infant mortality, entirely comparable to that for children born of alcoholic parents, is seen with illegitimate children. Between 1890 and 1900 the infant mortality rate for legitimate children in Berlin was approximately 20.0 per cent, and for illegitimate children it was more than double—42.0 per cent. In 1905 intensive social work was introduced for the care of illegitimate infants. Civic associations supplied milk and provided social workers for the supervision of child care. By 1913 the infant mortality rate for legitimate children had dropped to 12.0 per cent and that for illegitimate children to 19.4 per cent. After the first World War, owing to poor financial conditions in Germany, the work on behalf of illegitimate children practically ceased. By 1920 the infant mortality rate for the legitimate children was still 12.0 per cent, but that for illegitimate children had risen to 33.0 per cent. In 1923 national legislation for the care of illegitimate children was introduced and by 1926 the infant mortality rate for both legitimate and illegitimate children was between 9 and 10 per cent.

The fact that the high mortality among infants of chronic alcoholics is not due to the development of hereditary defects and inherent weaknesses is emphasized here for an important reason. If these unnecessary deaths are to be prevented, the facts must first be known. When the belief is held that the high mortality is due to germ damage, the prevention seems hopeless. Hereditary weaknesses cannot be remedied after the child is born. When, however, it is realized that the high mortality is not due to fundamental weakness of the child, but instead to home and social conditions, their remedy is no longer impossible.

4. *The occurrence of disease.* What has been said here regarding alcohol and infant mortality applies exactly to alcohol and the occurrence of disease in children. Disease is not due to weakness acquired by the child from the alcohol used by the parents; it is due to lack of prenatal care and neglect of the child after birth because of the excessive drinking habits of the parents.

5. *The occurrence of feeble-mindedness, epilepsy and mental disorders.* The occurrence of mental disorders, feeble-mindedness, idiocy and epilepsy is much more frequent among the offspring



excessive drinkers who came from families of bad stock—and as we have said many do—16.5 per cent of the children showed mental abnormalities.

### THE HEREDITY OF ABNORMAL DRINKERS

THE first question we deal with here is: Is the craving for alcohol inherited? If we wished to take advantage of technicalities, our answer would correctly be "no, it is not inherited." We could make this answer because abnormal drinking and the craving for alcohol are acquired traits and acquired traits are not inherited. If, however, we phrased our question another way it would perhaps express more nearly what the reader has in mind on the subject and the answer would be different. To the question, are the children of alcoholics more apt to become alcoholics themselves than are the children of temperate parents, the answer is definitely "yes."

There are three reasons why the children of alcoholics tend to become alcoholics and none of these comes from any alteration of heredity caused by alcohol itself. The reasons are:

1. The poor home environment of the alcoholic family, the neglect of the children and lack of parental control are fertile grounds for the development of the habits of excess.

2. The children find in their parents an example of excessive drinking and they tend to follow this example.

3. Many excessive drinkers come from families in which mental disorders and abnormalities of personality are inherited traits. Individuals with such inherited traits are often much less able to resist intemperance to alcohol than are normal individuals and so become excessive and abnormal drinkers.

The particular questions which concern us here are those which have to do with the last of these items. Their importance lies in the fact that while environment—home life and parental example—can be controlled, heredity, once the child is born, cannot be altered. If a weakness which predisposes to poor adjustments, such as alcohol addiction, is inherited, then the children of alcoholics will tend to become alcoholics. It is highly important to find out what proportion of alcoholics are predisposed by inheritance.

TABLE 4  
*Hereditary Liability of Chronic Alcoholic Patients*

<i>Report No.</i>	<i>No. of patients</i>	<i>Sex</i>	<i>Patients with tainted heredity, per cent</i>
1	909	M	37.0
2	166	F	42.2
3	728	M	32.7
4	180	M and F	48.3
5	191	M and F	40.8
6	420	M and F	35.2
7	207	M and F	41.5
8	300	M and F	32.0

Many investigators have shown that beyond question the great majority of alcoholics have mental disturbances and abnormalities of personality. These disturbances and abnormalities although not due to alcohol nevertheless predispose to alcoholism. But the fact alone that such abnormalities exist does not prove that they were inherited or that they will be passed on to children which the alcoholic may have. The fact that the abnormalities exist in the alcoholic himself does not justify the statement, often made, with its implications of hopelessness, that these traits must pass to the children—that the children of alcoholics, by fate, must be alcoholics.

When one examines critically the maze of statistics that have been gathered on the heredity of excessive drinkers it becomes clear that the results obtained depend upon what sort of drinkers were studied. When the investigation is limited to true alcohol addicts, and to alcoholic criminals who are in institutions, more than 75 per cent have ancestors with definite mental disturbances and abnormalities of personality. But when the investigation is broadened to include what may be called "general run" of alcoholics, the figure drops to about 40 per cent.

Forty per cent is a high figure, some 8 to 10 times as high as for the public at large. It corresponds, in a general way, to the figures given in Table 3 showing the percentage of mental disturbances and abnormalities of personality in the children of

alcoholics. It indicates the true picture of the part that heredity plays in the development of excessive use of alcohol.

If the ancestors of the alcoholic have shown a high percentage of mental disturbances and abnormalities of personality, he, and his children as well, will have a tendency to maladjustments including alcohol addiction. If the ancestors of an alcoholic did not show these traits, then his habits and those of his children cannot be properly attributed to his heredity.

### Conclusions

1. The use of alcohol does not injure the human germ and cause abnormalities in heredity.
2. Excessive users of alcohol frequently come from families of poor hereditary stock.
3. The defects they inherit are not caused by alcohol but they may predispose to alcoholism.
4. The greater incidence of disease and mortality among children whose parents are abnormal drinkers, as compared to those whose parents are temperate, is not due to germ damage. It is due to the low standards of living and to neglect in the homes of excessive drinkers.

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