BROTHERS COLLEGE

Temperance Physiol Effects of Alcohol

The Influence of Alcohol Upon the Race

By

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Supplement—Summary of a Study by Dr. Charles K. Stockard from Parents and Ancestors Treated With Alcohol

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INTERNATIONAL SERIES No. 6

WESTERVILLE, OHIO
American Issue Publishing Company

Editor's Note

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The Influence of Alcohol Upon the Race

DR. PLOETZ prefaces his treatise on the effects of alcohol upon race welfare with a few observations on the chief characteristics of life,—its enormous duration, its manifestation as motion in connection with differentiated protoplasm, its branching course into streams and sub-streams. The individual does not truly represent life because after a time he ceases to exist. But the generations preceding, including and succeeding his show life in its continuity. Because of the diversity of the protoplasm in which life is manifested it has separated into numerous streams which, becoming more diversified, are known as races, species, tribes, families, etc.

In order to ensure their separate continuance these streams must be composed of enough individuals to withstand all destructive external influences and leave a safe margin against the injurious effect of in-breeding.

A race, Dr. Ploetz defines as the largest group of individuals which can defend themselves against approximately like destructive or otherwise sterilizing influences, and which therefore closely resemble one another in their inherited characteristics.

Not all forms of life are capable of improvement. Some now existing have developed no further through millions of years. Where improvement does not take place, it is not the single individual or the entire class that keeps constantly tending in the new direction, but a certain large part which by mating with other individuals of the same tendency, and in competition with other less well endowed varieties, gradually evolve new forms.

We see that the class that makes the greatest development is limited by the same factors as the class that maintains the life stream, and that the race represents not only a maintenance unit but a development unit.

Does Alcohol Promote Race Improvement?

The role that alcohol plays in the life of the individual can be considered as established with tolerable clearness, but the part it has in the economy of the race is yet the subject of lively controversy. One side believes it one of the chief causes of degeneracy, and hopes by a strong abstinence movement to elevate the general level of capacity; the other regards its effects as an elimination of the unfit, and, therefore, a means of promoting development, and believes that a general abolition of drink by legislative coercion would result only in protecting the drinker type from extinction, leaving him undisturbed to procreate his kind. This would leave the race so overburdened with potential drinkers that sooner or later drinking would break out stronger than ever. This side taking this view compares the efforts of those opposing alcohol to that of a man who, wishing to breed a long-tailed race of dogs, should carefully select all the short-tailed dogs and pull their tails with all his might.

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The representatives of the idea that alcohol promotes race welfare by eliminating the unfit are chiefly the three English biologists, Haycroft, Reid and Headley.

Such a sweeping opinion which tries to explain scientifically that all the efforts of a century against alcoholism on the part of the state and numerous private individuals are not only useless but directly injurious, calls for a thorough examination of the total role that alcohol plays in the race economy.

Vigor Essential to Maintaining Quantity

The course and development of a race are directed first of all to the maintenance of a certain number of individuals whose condition is, in turn, determined by their efficiency in the struggle with nature and other races. This efficiency depends upon the development of hereditary mental and physical qualities, that is, upon constitutional abilities.

The preservation of the *number* of individuals is dependent first upon the birth and death rates. If the race is to be preserved or to grow vigorously there must be an excess of births over deaths. Apart from environment, birth and death rates depend upon constitutional abilities whose preservation and improvement we will now consider.

The following are the fundamental principles involved:

Selective and Non-Selective Influences

The descendants of any generation vary in their abilities from their parents and from one another.

The influence exerted upon these variants by the environment in which they live varies with their power of resistance. But there are other powerful influences, to which both strong and weak are alike exposed, that are without relation to this difference in resistance, and that injure, destroy, or render infertile all alike. *These are called non-selective processes.* Other influences are so graded that only a part of the variants suffer from them, those who are unable to offer the resistance shown by the stronger individuals. *This process is called selective elimination.*

The result is that in the struggle for existence a larger percentage of the most capable individuals are preserved and have a larger proportion of descendants than the weaker. The struggle for existence so operates that the progenitors of a succeeding generation are a selection of the more capable as compared with the preceding. Furthermore, since the more capable progenitors, in accordance with hereditary law, produce more capable descendants than the incapable, so the struggle for existence, like the conditions of variability already mentioned, acts as a great protector of the race from degeneracy, and by causing improved variants makes it possible to raise the level of the race as a whole by the average constitutional strength of the individual.

The influence of the struggle for existence is the more favorable in this direction as the environment becomes more trying, but it begins to work unfavorably when the elimination of the individual reaches such a stage that the relation of birth to death rate compares unfavorably with that of other races. The higher the excess of births and the greater the efficiency of any race, so much more favorable will be its position in comparison with others.

Now, what influence does alcohol have upon the race process just outlined? Is it purely useful, or useless, or both? Or what is the connection between use and injury?

[On first thought it might be supposed that the answers to these questions could be obtained by simply comparing the per capita consumption of alcohol in different countries with their respective rates of birth and death, suicide, mental disease, military efficiency, etc. But the question is not so simple. There are too many incomparable factors. Of these, Dr. Ploetz gives illustrations.]

Four Classes of Drinkers

In order to determine the effect of alcohol upon the economy of the race, there is no other way than to observe its effect upon individuals and groups of individuals, and then to draw conclusions from these observations.

Wherever there is drinking in a nation, it is found in every degree from abstinence or extreme moderation to the worst swilling. To facilitate our observations in racial biology, I will distinguish four degrees in the use of liquor, though without any thought of maintaining that sharp lines of division can be drawn.

Since alcohol interests us only so far as its effects on men is concerned, and since individuals react very differently to the same amount, I will classify various degrees of use, not according to the absolute quantity, but according to the effect.

Degree 1. The *harmless use,* when such slight amounts are taken at such long intervals that the effect is always entirely obliterated and the body restored *ad integrum.* For the average man this means the use of such extremely small quantities of alcohol that it borders closely upon abstinence. But this does not prevent there being a diminution of the capacity for work, especially for mental work, while the effect lasts. Weariness, for example, is also a condition that is connected with a diminution of the working-capacity, and yet the body recovers from it without being at all impaired.

Degree 2. The *very moderate use,* when, in consequence of the greater quantity taken or the shorter interval between successive doses, the regulative mechanism of the body is no longer able to bring about complete restoration of the mental and physical functions. The drinking included under this head does not, however, affect the germ cells beyond their power of recuperation.

Degree 3. The *less moderate* use, when quantities and intervals are such that not only is there a greater injury to body and mind, but the germ cells also begin to be injured beyond their power to recuperate. The *quality* of the offspring suffers. But the processes of recuperation are not yet so seriously impaired as to lessen demonstrably the *rate* of reproduction.

Degree 4. The *immoderate use,* when the quantities taken are increased so much, or the times of drinking follow one another so closely, that the injuries to body, mind, germ-cells and offspring reach their maximum, and the rate of reproduction suffers in all degrees up to total loss of the power of procreation.

Reasons for Classification

A word or two in justification of this division. I have differentiated a harmless degree as over against the other three injurious degrees, but of course it must first be rigidly demonstrated that there is a complete restoration in the strictest sense even after the use of the smallest quantities.

We have at present no data by which to show the injuriousness of minimal doses, but complete restoration is made highly probable by observations in daily life, by the experiments of Kraepelin and his school, by the discovery of Nencki, of alcohol in ordinary intestinal digestion, and by analogy with the usual conduct of living substance which, according to experience, is able to recover from disturbances caused by slight external influences.

In all the three higher degrees, on the other hand, the regulative power of the body is exceeded, and the body is altered, deteriorating because it does not regain its former state of vigor. This may occur with relatively small quantities, provided they are taken daily.

The new influence sets in before the old has passed off and the effect is cumulative, so that the working capacity is lowered, temporarily, if followed by abstinence, and recoverable; but, with large amounts following each other more frequently, ability is only partly restored even by abstinence and the remaining part is unrecoverable. Heavy drinking increases the unrecoverable part and leads finally to the total ruin of the drinker.

There is no doubt that a slight diminution of individual ability can be discerned as the result of degrees of use that do not according to our ordinary mode of judging, cause any diminution in the natural endowments of the offspring. This fact, I think, warrants us in distinguishing the second, very moderate degree of use, which injures only the individual drinker in his working capacity, from the third, the less moderate degree, and the fourth, the immoderate, both of which cause injury to the progeny also.

It might be objected to this classification that the various organs are differently affected in different individuals, as is well known, hence in some persons the germ cells will, occasionally, but not regularly, chance to be injured less than in others, as generally a larger quantity of alcohol is required to injure the germ cells than simply the body cells. In addition to this, is the personal observation that I have myself made from a large collection of family tables showing that in families where the children manifest injury, even though slight, from parental drinking habits, the parents have long before suffered physical and mental injury, and they show also, on the other hand, that a parent may suffer a slight degree of injury from drinking habits and yet the children on the average may not be worse than those of very temperate parents, and this we learn also from the general condition of the people. For if the widespread moderate drinking, so-called, of the middle ages particularly, had affected the germ cells of our forefathers in the same degree that it affected their body cells, we should long ago have been in a state of decay.

This supposition that larger quantities of alcohol may be required to injure the germ cells than the body cells would seem to be borne out by the special provision nature has made for the protection of these cells, placing them deep in the body out of reach of ordinary external injury and so ensheathing them as to hinder their rapid absorption of poisons that might be circulating in the blood.

These considerations lead to the decision that the term *very moderate use* can be applied only to that degree of drinking that injures the body cells but has not yet injured the germ cells. Thus a natural classification may be reached by observing the condition of reproduction as the degree of addiction to alcohol advances.

Degree of Blight Follows Degree of Drinking

Reproduction in the strict sense of the term is the production and rearing of progeny *until the time of their complete maturity*, that is, until they are themselves

fully able to reproduce. Now, the usual course of events in the case of drinkers is as follows: At first, slightly degenerate children are produced; then as the drinking becomes more and more immoderate, the degeneration increases and leads to a greater mortality before maturity, until, finally, when there is extreme drinking, sterility sets in. Moreover, when one compares relatively light drinkers with those who from the beginning drink more heavily, one finds in general that in the case of the former, notwithstanding the slight degeneration of the children, the number reaching maturity has not suffered at all, whereas in the case of the heavier drinkers, there is, in addition to more serious degeneration and partly on account of this, a diminution in the number, or even total loss of productiveness.

Hence, in propagation by drinkers, quality suffers first, then quantity. Consequently, the higher degrees of alcoholic consumption are readily separated into the *third, the less moderate degree,* which injures reproduction only by impairing the natural endowments of the offspring, and the *fourth degree, the immoderate use,* which injures reproduction not only by impairing more seriously the natural endowments, but also by reducing the rate, whether by increased mortality of the children before maturity, or by direct diminution of the number produced until sterility is reached.

I would not, of course, maintain that in absolutely all cases the increasing use of alcohol injures the germ cells only after it has first injured the body, and that the injury at first affects only the quality of the posterity and not until afterwards the quantity. But it seems certain to me that this order is the rule, at least, and departure from it the exception.

Defense of the Class Names Chosen

It may be questioned whether I have properly named the four grades of drinkers which appear to me to constitute the only practical classification (one might separate a still higher degree of drinkers whose rate of reproduction is *null*) whether the second and third classes particularly are rightly named. I have chosen the terms "very moderate" and "less moderate" because the use which is usually termed "moderate"—by many physicians as "so-called moderate"—includes with most individuals the second and third degrees. Many from whose drinking slightly degenerate children have already proceeded, and who refer to it with confidence as their friend, would never be placed by others in the category of "moderate." On the other hand, the injurious use, the first grade, applies to quantities so small that they do not approach the amounts that are usually designated as very moderate. There is, therefore, nothing else to do but to apply the word moderate, corresponding to popular use, to the second and third grades. To differentiate the two degrees from each other there is scarcely any other way than by the words "very" moderate and "less" moderate.

Effects of the Four Stages Upon Efficiency

We will now consider more closely how the four degrees of use affect the individual in those activities of life which are of most importance to the race.

As regards the performance of physical and mental work, the four degrees cause a progressive diminution of the amount that could otherwise be done. Strict training in preparation for arduous athletic performances demands not simply great moderation in the use of alcohol, but total abstinence.

Regiments of soldiers accomplish more without alcohol than with it. The same is true of type-setters. North Pole explorers have had similar experiences. Helmholtz declared that the smallest amounts of alcohol were a hindrance to scientific conceptions. Goethe said: "I drink almost no wine, and almost daily I gain in

fitness and in broader views of life." Again, "If I could abolish wine I should be happy." Schiller never drank much and was very moderate, but in temporary physical weakness he sought to increase his strength by liquor or similar spirits. This affected his health and even impaired his productions. Furthermore, there results from the diminution of the working capacity an increase in accidents, since frequently there are situations in which even a slight relaxation of physical energy, sense-perception, attention or power of association is enough to bring about an accident.

All the various functions of the body and mind are subjected by the use of alcohol to a deteriorating influence in consequence of its temporary effect. But this is not all. In the case of the second, third and fourth degrees of use, these functions suffer further because the organs do not fully recover, and the level of their working capacity is temporarily or permanently lowered.

This, of course, holds true of the moral functions of the brain as well. Intoxication of the last three degrees injures the higher organs of inhibition not only during the temporary, but also during the permanent effect of the alcohol, and thereby enhances in increasing ratio the inclination to follow criminal impulses, which are themselves often intensified by alcohol. This is especially true of criminal brutality and immorality.

The high percentage of drinkers among these criminals and the frequency of offenses on the days when alcohol is used testify to this connection. Everyone is familiar with the breaking down of drinkers in ethical directions, which finds an expression particularly in the sorrowful conditions of family life.

Effects Upon Susceptibility to Disease and Length of Life

A further effect of the injurious use of alcohol—that of the last three degrees—relates to the increased susceptibility to disease. As has been shown by the experiments made upon animals by Gruber, Laitinen and others, alcohol facilitates the contraction of all sorts of infectious diseases, especially pneumonia and tuberculosis, and favors or occasions a great variety of other maladies, such as mental and nervous diseases, gout, obesity, hardening of the liver, inflammation of the kidneys, etc. Further, it increases the possibility of contracting contagious sexual disease, not so much, indeed, by its chemical action upon the tissues, as indirectly by its effects upon the sexual impulse, which it intensifies, and upon the moral and intellectual inhibitions, which it paralyzes.

Where the yearly number of days of sickness in benefit societies of abstainers and non-abstainers has been investigated, it has been found that the number of sick days at all ages among adult men members was one-half to one-third less among abstainers than among other classes, which included the drinkers.

The reason for the greater morbidity is to be seen not only in the direct physiological effect of alcohol, but also in the indirect effects resulting, first, from the fact that a large part of the income, especially among the poorer classes, is spent for alcohol (brandy, beer, wine, cider) and is therefore not available for the necessary food supplies; and secondly, from the fact that, on account of the decline of his working capacity, the drinker comes to poverty, want and squalor, all of which increase the tendency to disease. This same direct effect of alcohol by lowering the dietary has an influence, of course, upon all the activities previously mentioned, for without sufficient food neither the mental nor physical functions can reach their highest possibilities. This direct effect holds also as regards mortality.

The length of life of the individual is shortened in increasing ratio by drinking of the second, third and fourth degrees. This is shown partly by what has been said above as to the increase of accidents, crime, poverty, diseases, etc., and partly

by mortality statistics. In these occupations which have to do with alcohol, such as those of brewers, saloonkeepers, bartenders, we find an extraordinary high mortality. In the years 1891-1899, according to official medical statistics, fifteen large cities of Switzerland, with about 560,000 inhabitants, lost from the direct or indirect effects of drink, 10.5 per cent of the men between the ages of 20-40 years, and 15.5 between 40-60. That even the lighter degrees of drinking shorten life is made clear by the statistics of English life insurance companies, which showed that the abstainers lived longer than the other insured classes, that is, than the moderates; for immoderate drinkers are not insured in these societies.

Effect of the Four Stages Upon Reproduction

The facts illustrating the degeneration of the children of drinkers have been brought out so often at these Congresses and on other occasions that I refrain from taking up the matter in detail. I can only refer here to the investigations of my teachers, Forel, Demme and Bunge, and especially to the family statistics of Demme, Legrain, Dugdale, Stark, Arrivée; to the animal experiments of Mairet and Combemales, Hodge and Laitinen, and to the investigations of the frequent occurrence of drunkenness in the parents of idiots, epileptics, insane, criminals and all kinds of degenerates (to name only the family investigations of Koller made under the direction of Dr. Forel), all of which agree in showing that drunkenness in the parents leads to degeneracy in the descendants. I would refer further to the important investigations of Bunge, who concluded from an inquiry into some 600 cases that alcoholism in the father is a chief cause of the loss of ability of the daughter to nurse her children. Professor Bunge authorized me to state that 700 additional cases which he has since collected furnish still stronger evidence of this connection.

Demme's work, though limited, is very instructive for our purpose, hence I will speak of it more particularly. He compared ten drinking families with ten very moderate families, all living under similar conditions and selected with reference to obtaining the largest possible number of children. The children of the moderate users were 82 per cent healthy and sound; of the immoderate users, just the opposite, 82 per cent degenerate and only 18 per cent apparently normal. The degeneracy increased with the number of drinkers among the antecedents.* Where both father and mother drank, not a single child was normal.

The material of all these investigators was drawn chiefly from the class of heavy drinkers [Degree 4] and the heavier of the less moderate [Degree 3], but that of the lighter grades of less moderate drinking lead also to degeneracy, although of corresponding lower degrees, is clear, for the wide difference between the 82 per cent of abnormal children among the drinkers and the 18 per cent among the very moderate cannot be simply a matter of chance.

The results of other investigators have been the same in principle, even if not so definite in numbers.

The degeneracy found in the children of alcoholics, when compared with that in the children of the general population, discloses, as in Demme's cases, a wide gap. To assume that this gap seen in the investigation corresponds to a similar difference in the second generation would be, from the biological standpoint, sheer nonsense. One is compelled, therefore, to search for the transition from the slight degeneracy of the children of the temperate to the extreme degeneracy of the children of the

* In six of the 10 families the father and the grandfather had been drinkers. Of 31 children, 15 died at birth or soon after, 14 were abnormal, two only normal.
In three families the father only was intemperate. Of 20 children, eight died, five were abnormal, seven normal.
In one family, both parents were drinkers. Two children died early, three were abnormal, one, delicate in early life but later became approximately normal.—Editors.

intemperate, among parents who are no longer very moderate, and still not heavy drinkers, that is in the third or "less moderate" degree of users.

Even the Less Moderate Use May Lead to Degeneracy

In other words: The forms of degeneration that are produced by the use of alcohol on the part of parents are, in less serious cases, produced by less moderate drinkers [Degree 3], and in the more serious cases by immoderate drinkers [Degree 4]. *Hence, even the less moderate use may lead to degeneration of the children. This must be particularly emphasized.* It is hard to say what absolute quantities on the average are here concerned; they differ for different individuals. But it is certain that a large part of what is popularly designated as moderate use extends to the third, the less moderate degree.

Outward Manifestations of Injury

As regards the directions taken by the degeneration, bodily malformations are largely predominant, for example, diminution of stature and of the size of the cranium; but, on the other hand, there occur also a tendency to hydrocephalus, a disposition to tuberculosis and to mental and nervous diseases, moral defects that carry with them a tendency to criminality, all stages from the slightest weak-mindedness to the worst imbecility, etc.

Nature's Mending Process Stopped

The deleterious influence exerted upon offspring through the use of alcohol by the parents does not by any means necessarily show itself simply in manifest forms of degeneration. It may act in more latent fashion by *preventing regenerative tendencies from being realized in full or in part,* tendencies that would otherwise perhaps have restored to a normal, average capacities which, in the case of the parents, were defective in some respect or other. Or, again, the influence may show itself in *injury to any tendencies to progressive variation,* or in a complete nipping of them in the bud. This is especially important where unusual intellectual endowments are concerned.

Where Quantity Suffers

As has already been stated, we find the more serious forms of degeneration in the fourth degree of use, the immoderate use. Here, too, the quantitative diminution in reproduction begins. Since doubt has often been cast upon this from authoritative sources, and the point is very important for the question whether there is an elimination of drinkers in progress, we must take up the matter somewhat in detail. Reproduction, we saw, means the producing of a certain number of children and bringing them up to complete maturity, *i. e.,* to the time when they themselves are able to reproduce.

In regard to the number of adult children one can distinguish an absolute and a relative difference. The *absolute* difference exists when the parents have reproduced themselves, that is, two adult descendants; the *relative* difference when the parents have produced as many mature children as that of the parental average of the race, that is, have maintained their family proportion in the new generation.

Absolute reproduction, therefore, means simply replacing the absolute number of the parents; relative reproduction is the replacing of their proportionate part in the race. If the rate of reproduction falls more or less behind that of the race average, it signifies more or less of a defeat in the struggle for existence except in the case of non-selective influences [i. e., those that injure without distinction the fit and the unfit]; if reproduction exceeds the racial average, it betokens a victory.

High Infant Mortality of Drunkard's Children

Now the rate of reproduction can be lessened in two ways; first, by greater mortality of the children before their maturity, and, secondly, by diminution of productivity itself. That the mortality in the families of drinkers is very great may be learned from observations of numerous investigators.

The intemperate families in Demme's observation lost 44 per cent of their children in the first months of life, in contrast to an 8 per cent loss by the temperate. Kende found in 21 families where both parents drank, an infant mortality of over 60 per cent. Arrivée found that in 81 intemperate families belonging to the laboring class, 57 per cent died before the sixth year. The 600 children of Sullivan's drinking women gave a mortality of 55 per cent up to the second year, while among sober mothers, belonging to the same social scale, the corresponding mortality was only 23.8 per cent.

Sterility of Heaviest Drinkers

As to the diminished productivity of the heaviest drinkers, there can be no doubt. The earliest work on this subject was done by Lippich in Laibach, who studied 200 men and women inebriates. Of the married men alcoholics, 19 per cent were without children, of the women 28 per cent, which is from two to three times the usual proportion. As a result of his observations, he asserted that the heavier the drinking, the higher the infertility. Of Kende's 21 families, in which both parents drank, 10 were sterile, while in the remaining 11 families only 24 children were born, a little over two to each.

A medical society in Ringköbing, Denmark, investigated 132 drinkers who were treated there from 1881 to 1890. Of the married drinkers not less than 40 per cent had no children. These Danish figures do not, of course, in a strict sense, prove a diminished fertility, since they do not tell us whether the marriage period was ended or whether this loss of children was associated with an abnormal infant mortality, but they make the diminution of productivity highly apparent. A fact that contributes still further weight is that, according to the observation of Sullivan and others, the productivity rapidly decreased with the duration of the drinking course. Statistics as definite as those of Lippich's were furnished by an investigation of Simmons. In autopsies on 1,000 male corpses he found the spermatozoön absent in 125 cases, and 60 per cent of these were chronic alcoholics.*

Let us consider now the significance of these and similar findings of increased infant mortality and diminished productivity for the reproduction rate of the chronic drinker.

Since the less moderate use of alcohol has only slightly degenerative tendencies, such use on the part of parents can only very slightly increase the mortality of the children. For, many forms of slight degeneration, as, for example, certain ocular defects, can be artificially remedied (by glasses, etc.) to such an extent that they hardly count as a disadvantage in the struggle for existence; a diminution of stature may bring exemption from military service, etc. By acting only as a handicap, an advancing variation does not as a rule involve a rise in infant mortality. But slight degeneracy must, nevertheless, produce a slight weakening in the struggle for existence and, therefore, must occasion an increased, even though small, mortality in the succeeding generation. Nevertheless, it is not to be assumed, or concluded even from the study of families, that a lowering of the reproductive rate has already set in. The complaints that I have heard in my practice, from mothers having many children,

* See also Bertholet: Anatomico—Pathological alterations observed in the autopsies of 100 chronic alcoholics. Report of the XII International Congress Against Alcoholism.—Editors.

have given me a distinct impression that the less moderate use of alcohol leads parents to thoughtless procreation that would otherwise be avoided. This is doubtless owing to the frequent alcoholization of a mild type.

The first slight increase in the mortality of children is, therefore, counterbalanced by a slight increase in productivity. Where that is not the case, because the degeneracy and mortality of the children increase as a result of heavy drinking, while the fertility of the parents gradually decreases, we then have to do [not with the third class but] with the fourth class, the immoderate users.

Researches That Show the Drunkard's Defeat

As a class, the immoderate drinkers fall below the full relative reproduction rate, the race replacement rate, and often below the absolute rate, that of reproducing the parents. Here, then, is a partial or total defeat in the struggle for existence, a weeding out.

In view of the importance of this point, I will refer for its support to existing material as far as it is accessible to me.

In the ten intemperate families of Demme, 57 children were born. Of these, 26 died before maturity, 7 were idiots, and of the remaining 24 children, 5 failed as candidates for marriage on account of softening of the brain and dwarfed development, so that only 19 were left. Hence, in the ten families there was not a full replacement of the parents. To this is to be added, that these remaining 19 were for the most part still in the age of childhood, and hence liable as tribute to mortality until the period of adolescence. Furthermore, one of the children was afflicted with club-foot, one with double hair lip, 5 with epilepsy, and only 10 were normal, but not yet arrived at maturity and child production. These marriages were well advanced and children born somewhat later would make little difference in the result, for, as already remarked, the fertility and especially the vitality of the drinker's children decline rapidly with the duration of the marriage.

Similar conditions existed in the 382 children born of the 81 intemperate families of Arrivée. Only 164 children reached the age of 6 years. That was far below the replacement rate of the race, but not below that of the parents. Among these 164 children there were a number of idiots, epileptics, mentally diseased, and a full third who were tuberculous, so that, by the time of adolescence, so many would have died or have become incapacitated for parenthood that there was little certainty of replacing even the parents, hence a full absolute reproduction even was quite out of the question. As we have already seen, the later in the marriage period the children were born, the worse their condition.

Kende's figures showed that of 24 children in 11 intemperate families, 16 died early, of which only 3 appeared normal.

Sullivan's 120 drinking mothers, corresponding to about 240 parents, had 600 children of which only 219 lived beyond the first year. Here also in both cases is a falling off below the absolute reproduction rate.

From Individual to Race Injury

Having now become to a degree familiar with the effects of alcohol on the vital functions of the *individual*, we will see how it must influence the economy of the *race*.

By diminishing the births and increasing the deaths, alcohol has a tendency to lower the excess of births over deaths. By devoting incomes to unproductive purposes, by impairing the quality of the diet, by weakening the desire to work, by increasing physical and mental disease, crime, accidents, premature invalidism, etc., it heightens considerably the internal friction of the race while it decreases the total efficiency considerably.

But all three tendencies, the lessening of the excess of births over deaths, the reduction of the total working capacity, and the increase of inner friction, directly deprive the race of a part of its energy in the struggle for existence with other races and the rest of its environment. The ratio between births and deaths affects not only the number of workers, but also that of soldiers and emigrants, upon whom the wider diffusion of the race depends. Moreover, the unproductive expenditures may amount to large sums.

The German Empire expends annually about 2½-3 millions of marks for alcoholic liquors, that is to say, it uses a large part of its land and labor for nothing and worse than nothing, for flabby bodies and dull heads, instead of making sinews tense and brains clear for the great struggles, whether of peace or war, that lie before it.

Effects Upon Possibilities of Race Improvement

We will not, however, begin to preach, but simply investigate further.

The preservation and improvement of inheritable capacities depends, as we have seen, upon favorable or unfavorable conditions of transmission and variability in the descendants and upon the extent and direction of the eliminating forces which affect the lives and reproduction of the descendants through the influence of external and social environment.

Everyone is completely eliminated who either dies before adolescence or fails to marry (in the natural sense) or has no children, or children all of whom die before maturity, that is, in a word, who do not reproduce themselves. Those are partially eliminated who bring fewer children to maturity than corresponds to the average for the race, and the smaller the number of such children the greater the degree of elimination.

From the foregoing explanation it is clear that, in general, alcohol in the fourth degree of use, the immoderate, causes elimination; for by inducing a high rate of mortality among children, and frequently also by diminishing productivity, it brings the reproduction not only below the average increase of the population, but oftentimes even below replacement of the parents, and reaches the extreme limit in their complete elimination by reason of sterility.

The question, then, is: What specific qualities or defects have those who are eliminated by alcohol? Does alcohol play the part of an overwhelming power that seizes and fells good and bad without discrimination, or are only individuals with certain bad characteristics seized and injured, or if the seizing takes place without regard to quality, upon what does degree of injury depend?

All these forms of action are found side by side: *Alcohol obtains its victims and eliminates both selectively and non-selectively*, that is, with discrimination and without. If a mother, following the wise deliverance of the family physician as to the strengthening qualities of Tokay wine, gives her child wine regularly, and if this child then becomes a light drinker and later a heavy drinker, the injury resulting from the physician's advice is doubtless entirely undiscriminating, non-selective. If a jolly fellow in the exuberance of his youthful vigor devotes himself ardently to student drinking customs, and in a state of exhilaration contracts gonorrhoea, which renders him unproductive, that is, indeed, a selective [discriminating] elimination in so far as a less impulsive or more prudent young man would have escaped the danger; but it can not be said that the choice was based upon innate inferiority. For the high-spirited youth, whose unbridled sense of strength was his ruin, might, by reason of the same characteristic, be a valiant, dashing trooper on the field. Since wars still play a part today in the racial struggle for existence, it is an advantage that there should be such natures.

Selective and Non-Selective Elimination

The idea, based upon certain scientific calculations, that alcohol is a good, nourishing and strengthening material, the practice of giving alcoholic drinks to children, youthful high spirits, in many cases probably the factors of social drinking customs and financial difficulty are the chief causes, at least, of alcoholism that injures non-selectively. The only effect of these on racial biology is a diminution of the excess of births and of general efficiency, accompanied by greater internal friction and degenerative tendencies. This, of course, can not exercise a selective elimination.

Where Weeding Out, or Selective Elimination Works

As a rule, the cases where individuals fall out through drink, independent of fitness or unfitness, are of considerable less frequency than the cases where some defect in character, in intelligence, or in the body, gives rise to the more or less serious injury from alcohol.

Two things must be distinguished, the lessened ability to resist taking injurious doses, and lessened ability of the organs to resist the effects of the poison taken. Individuals differ greatly in both of these directions. There are plenty of people, and not alone among women, who either have no inclination to take large amounts or have a pronounced disgust for it as soon as they have taken only moderate quantities, while others have given up the use of large amounts for the sake of internal comfort, and others from moral considerations. Here undoubtedly a selective influence is at work, and individuals who have a tendency to alcohol are, on the average, injured sooner and weeded out oftener than other individuals with normal instincts.

Inability to Resist Taking Injurious Amounts of Alcohol

Usually it is inherited defect or acquired injury of the nervous system that disposes to drink, showing itself either as a strong impulse to get intoxicated, or as weak inhibition against taking large quantities and repeating them frequently. The descendants of drinkers especially, or of the mentally diseased, epileptic, eccentric or vagrant, etc., have the disposing tendencies to drink. Among the races, these are found most frequently among the lower. The greater or smaller resistance against the taking of large and frequent doses determines whether the drinker will continue among the group of smallest users or will progress to the group of largest users, and thereby determines an increasing tendency to become eliminated. Most men among us remain in the second and third degrees because with them the relation between the impulse to take alcohol and mental restraint is still relatively favorable. For the majority of men the use of alcohol has no increasing tendency as is so often believed.

Inability of the Organs to Resist the Effects of Alcohol

A second point in selective elimination by alcohol relates to the varying resistance of the organs against the quantity taken. In this the size of the body is to be mentioned first. In student-drinking, for example, the amount of alcohol taken in conformity to the rules averages about the same for individuals who are placed under similar circumstances of inclination and restraint as to the taking of alcohol. But since the members of the student body vary greatly in size, from 60 to 90 kilograms (from 156 to 234 lbs.) in normal constitutions, the large man has the greater advantage, as the same amount of alcohol is distributed to a larger quantity of living substance than in the smaller man. If a man weighing 234 lbs. takes 5 liters of beer, equal to 200 grams of absolute alcohol, he gets 2.2 grams of alcohol to 1 kilogram of living substance, while one weighing only 156 lbs. gets 3.3 grams, about a half more. Similar conditions prevail in the drinking, treating, etc., among other classes hence under otherwise entirely similar circumstances the smaller body fares the worse, and has consequently a higher tendency to fall a victim of elimination.

The constitution of the organs plays also an important part. It is generally known that a like degree of drunkenness will carry off one person prematurely from liver cirrhosis, apoplexy, heart or kidney disease, or pneumonia, while another reaches a fairly old age, though such cases are, of course, less frequent. This signifies a very wide difference in ability to resist alcohol. The same is true of mental activity. Rudin found in his investigations of the influence of single doses of 100 grams on four educated subjects that while three of them showed a functional impairment, in the usual way, the fourth (the son of a nearly abstinent father) showed almost no effect, or very little.

There are wide individual differences also in the quality and rate of reproduction. In cases of about equal rates of drinking, where there is either a difference in the body weight of the fathers or a constitutional difference in the mothers, or other easily recognized causal differences as an explanation, it will be noticed that instead of the usual pronounced degeneracy of the drinkers' children, there is often only a light degree, usually in cases where the father appears to have been relatively little injured. The same applies to fertility. But so many other factors are involved in the reproductive results, especially the constitutional strength of their wives, which is a factor not easily estimated, that one can not speak of positive, but only of apparent individual differences in their reproductive powers. So far as I am aware, there are as yet no exact investigations dealing especially with differences in organic provisions for protection against the taking of alcohol. In this matter the difference in the inherited ability of the organs to exert some regulative influence against injuries as well as their native reserve powers plays a part, even though not so obvious a one as the bulk of the body.

So also in regard to the effects of the quantity taken upon the body, there are greater or less individual differences; some of these work for selection, some for elimination. Both kinds of variation often work together, so that in some men, though not in all, the taking of alcohol diminishes the mental resistance against taking more. Here one tendency toward elimination works through another.

How Alcoholic Selection Operates

If we now review the course alcohol takes in making its selection, through its eliminating action, that is, what individuals it preserves for progenitors, we can distinguish, in accordance with the foregoing observations, the following:

1. The selection of men who have less inclination to take alcohol, whether for direct gratification or for the sake of its intoxicating effects.
2. The selection of those who possess a strong mental and moral restraint against the taking of injurious amounts.
3. Those who have larger bodies.
4. Those who are better organized bodily for resisting the effects, not only of alcohol itself, but of the changes in function caused either solely or chiefly by the injurious effects of alcohol upon the organs.

From the strictly biological standpoint, therefore, two further distinctions are to be made in the process of elimination by alcohol. One aims at means of protection against other things as well as alcohol. This would include mental and moral restraint of the tendency to get intoxicated, a larger body, stronger reserve and regulative power of the individual organs.

The second method is the selection of characteristics which are fitted only for defense against alcohol itself, such as a dislike for it, and strong resisting power of the organs which have to deal most directly with alcohol when taken. Whether this second means of selection actually exists to any extent we do not know. But it

certainly would be completely and forever superfluous for a race that had banished alcohol, while the first means of selection helps to bring out other useful characteristics and as a result must be admitted to have a useful tendency.

Undesirables Produced Instead of Eliminated

But over against this usefulness of alcohol stands another effect, that is, the injurious influence of the less moderate and immoderate degress of use upon the conditions of transmission and variation. We have already illustrated that sufficiently so that here we may briefly refer to it.

First of all, it must be insisted that not only do the children of the drinker degenerate, as everyone now well knows, but that the descendants of the less moderate drinker [Degree 3] frequently show signs of degeneracy, even though slight. This is not learned directly from statistical observation, but from the conclusion that no sudden wide gap takes place between the relatively normal children of sound, temperate parents and the badly degenerate children of the drinker. The less moderate use of alcohol that lies between must supply the missing gradation.

A second point which deserves special mention is that the lighter impairment of transmission and variation does not turn out to be directly useful. It may consist of a lowering of the reserve powers of the descendants which are so important and, until recently, so little understood and appreciated. It may also be manifested in the stopping of regeneration. If the germ plasm suffers an injury, it can in many cases, like all living substance, partially or wholly recover. Not only may this be seen in the drinker who has been cured, who during his drinking period begot degenerate children, and, after long abstinence, children in whose condition there was a gradual improvement; but one must admit a tendency to regeneration even in the progeny since otherwise there would long ago have been a more widely extended average damage of the germ plasm.

According to all biological analogy, that variant is most liable to injury which, by reason of the completely developed germ plasm, is developed and fitted to advance the evolution of the race type. It is the most precious and sublime of all life activities and the first to incur danger.

The Eliminating Process Very Slow

Now the impairment of posterity in the sense of racial biology acts variously. So far as alcohol degenerates the children of parents who have become drunken and injured through unfitness, or defectiveness, it serves merely an elimination that extends beyond one generation. The elimination is not always entirely completed in one generation, but often continues through others. The work of the elder Darwin, Morel and Legrain in regard to the families of drinkers is here instructive.

According to their observations, complete extinction of the families of drinkers took place, on the average, in from three to five generations. Of the 50 intemperate families of Legrain, where both parents drank, there were only 17 living in the third generation, all in some degree so degenerate that there was no doubt they would all soon die out.

The case of the Jukes described by Dugdale shows that only in a few cases does the elimination continue through more than four to five generations. There the descendants of a drunken fisher and hunter did not die out until after seven to eight generations, after the families, intermarried, had amounted to 1,200 persons, nearly all of whom were shockingly degenerate, particularly in morals.

In the case of parents whose defectiveness gives rise to drinking of the less moderate type [Degree 3] degenerative tendencies are so slight that, as we saw, there is as a rule no elimination in the second generation, because reproduction is un-

diminished. Not until the following generation can the correspondingly weaker eliminating tendencies set in. Hence, naturally the process is either very long drawn out, or, especially when one parent has a very strong constitution, ceases altogether, so that in this case the elimination is neither rapid nor regular.

The Spoiling of Sound Stock

But so far as concerns the children of parents who did not contract the drinking habit as a result of inferiority, the great harmfulness of alcohol is quite evident. For here the able-bodied are also victims, and the degeneration of their offspring is no continuation of a process of elimination, but simply primary degeneration. Since in general this class of drinkers belongs to the less moderate [Degree 3] and less to the immoderate class [Degree 4], the degeneration of their children will not, on the average, reach a very advanced degree. This was true also of the children of the defective but less moderate drinkers, a class relatively very numerous, perhaps the most numerous of all.

Now, just on account of this slight degeneration the elimination of these descendants is a very protracted and, indeed, not always successful process. For the slighter the inferiority is, the less hold does it offer to injurious influences of environment, and the less easily will it be rooted out. These will, as a rule, afford no point of attack to the slightly injurious influences which have been tempered by environment such as personal hygiene, protection of the weak, etc. In such cases the individuals affected with the disability in question will fare as well as the able-bodied in the struggle for existence, so that here alcohol is one of the agents producing the minor variations that permit the deteriorating influence of panmixia—in the meaning given by Weismann to that term—to take effect.

Planting Instead of Uprooting Defectives

Through slight degeneration, therefore, the race becomes burdened with a multitude of inferior individuals, and that increasingly the more that drinking which does not exert a selective influence and the less moderate use [Degree 3] of alcohol are diffused. Hence when the consumption of alcohol is very widespread, the production of inferior variants, which has taken place quickly, overbalances the slow elimination brought about by the struggle for existence, and the inferior individuals must gradually accumulate.

To this is to be added the stoppage of regeneration and improved variants among a certain part of the defective drinkers, especially of the less moderate class, so that one is compelled, in the present diffusion of drinking customs throughout the civilized world, to believe that alcohol does more injury by its tendency to impair, through heredity and variants, than it does good by its eliminating tendency. For a part of its elimination even, it furnishes its own foundation by causing degeneracy in the posterity, thus first creating a part of the poor variants it afterwards ejects.

Briefly summarized, therefore, the effect of alcohol on the economy of the race, in the present state of our drinking customs, is bad: Diminution of births; increase of disease and death; increase of internal friction [poverty, etc.]; lowering of executive ability; a diminution of the total energy of the race in the struggle for existence. Reid, Headley and Haycraft put too much emphasis on the eliminating process and forget the degenerating action, particularly in the non-selective and less moderate drinker [Degree 3], in which class no such elimination takes place as does in the immoderate class. [Degree 4]

Moderation Injures the Race Worse Than Drunkenness

Therefore, attention must be called again and again with the greatest emphasis (as was done by me at the Basel Congress in 1895) to the fact that it is the less

moderate use, popularly called moderate, that injures the race more than actual hard drinking.

A still further consideration is that elimination by alcohol belongs to the same class as that due to great wretchedness and want in the individual, and to internal friction in the race, so that, from this point of view also, elimination by alcohol has its shady side.

The final effect of the alcohol factor in all these various directions can accordingly be expressed briefly and concisely: Alcohol is a poison to the race (though of course not the only one.)

How to Proceed for Race Improvement

Hence from the point of view of racial hygiene, an absolute and cessation of the drinking of alcohol is what is most desirable. So far as the degree of drinking is concerned, the one most necessary to abolish first would be the "less moderate" [Degree 3], next the "immoderate" [Degree 4], and last the lowest drinking rate, which, even if uninjurious to the individual, involves an injury to the race, even though small, by lowering efficiency.

With reference to the separate parts of the race processes, abolition of the use that does not weed out the unfit would naturally take first place. Our work, therefore, is to furnish a full explanation of the effects of alcohol to all classes, so that every one who drinks may know that he waters the roots of his strength with a poison.

The custom of giving alcoholic drinks to children must be strongly condemned and the pressure of drinking customs especially must be fought.

A part of the effort must be directed to uplifting those among the lower classes who are capable, but who live under degrading conditions as to food, housing and mental suggestions, to whom the door to alcohol stands wider open that it does to the well-to-do.

In regard to transmission and variation, the minimal condition to be imposed is that men who have the prospect of fatherhood must abstain from alcohol unless it be in the most moderate amounts [Degree 1, page 7] as must also, of course, expectant and nursing mothers.

The Most Practical Way to Eliminate the Unfit

In regard to elimination of the unfit the best method would be to completely abolish elimination by alcohol and substitute therefor some other kind of elimination which would act more quickly and more thoroughly, or other conditions of race hygiene that would promote the race economy, first of all by producing an improvement in the variants. The next best method of elimination would be in the sexual direction which would work relatively without pain and friction. If we could eliminate those defectives whom the craving for alcohol would root out, by preventing them from reproduction in denying them the right to marry, we should simply withdraw them from the race process. That would be possible with those who are only physically defective. But even the mentally defective might often be excluded by segregation or by forbidding marriage to criminals and the mentally unsound. Whether one can class with them those who have a craving for alcohol, I leave to be determined.

Women Should Boycott the Moderate Drinker

With the worst class, the less moderate drinkers [Degree 3] there should be a sharpening of perception in sexual selection, especially on the part of women. The moral perceptions must be awakened in regard to this class of drinkers. Women

should not wait for men teachers and writers to emphasize this duty. That would take a long time. But they should use every opportunity to prepare the women's movement to take up the matter of creating high ideals of manhood.

Other Remedial Measures

How to get rid of variations, how to improve, is the most important of all questions to obviate the necessity of elimination, but yet the most difficult to explain and practice. I will here mention only briefly some of the things in this field.

Improvement in the dietary of the many classes of people that are today undernourished, the prevention of reproduction by the syphilitic and the tuberculous, avoidance of too frequent child-birth and of reproduction by those who are too young or too old.

Race Evolution Demands Abolition of Drinking Custom

If we glance rapidly over the ground we have covered, we see that we have recognized alcohol as a poison not only for the individual, but for the race. The individual dies from his injury, but the race lives on. That which he injures roils the clear spring of life which flows through us and beyond us and from whose momentous floods all energy and beauty spring anew, and without which there is no powerful nation and no high civilization.

Wherever the race sinks, there little by little disappear the great mothers and the great men of science, of art, of statesmanship and of war, all of that stamp of men and women are stifled and the state in which this degenerate race lives sinks slowly out of the councils of the nations.

Hence, it is the duty not only of the physician and hygienist, but also of the modern statesman, to keep a sharp lookout for all possible sources of degeneracy and, therefore, for the injuries from alcohol.

We have not now behind us in reserve as in the days of old Rome, a vigorous, unexhausted, barbarian race. There is no race of unbroken higher power and habits beyond the limits of our civilization. We are the last and already hard-pressed muster and, because of the necessities which our evolution lays upon us, we must overthrow the tenacious drinking customs of a still more tenacious opposition.

Supplement

The editors include in this pamphlet, in addition to Dr. Ploetz's thoughtful study of the possibilities of harm to the human race through the vice of alcoholic beverages, a brief account of the important experimental work of Dr. Charles R. Stockard, of Cornell Medical College, New York, demonstrating actual injury to the parental germ in animals, since these recent experiments with large numbers of guinea pigs extending now to the fourth generation constitute a notable addition to the accumulation affects concerning the effects of alcohol upon the parent germ cell.

A STUDY OF ANIMALS FROM PARENTS AND ANCESTORS TREATED WITH ALCOHOL

THE accumulation of facts concerning the effects of alcohol upon the parent germ cell has received a notable addition from the animal experiments conducted by Dr. Charles R. Stockard, of Cornell Medical College, New York.

His first report, published in 1912[1] contained the result of 51 matings of guinea-pigs, alcoholic males and normal females; normal males with alcoholic females; alcoholic males with alcoholic females, and normal males with normal females. Of these, the normal pairs with nine matings produced 17 surviving young, no abortions, no still-born, no deaths soon after birth, no defectives, but all large, vigorous animals.

In contrast with these, 42 matings between pairs of which one or both parents had received alcohol resulted in only seven surviving young, five of which were runts, although all the parents were unusually large, strong animals.

The experiments were still in process when the first report was made, and a subsequent article [2] reports the results from a much larger number of matings, some of which include second generation animals, that is, the progeny of one or more alcoholic parents.

Taking the classes of animals in order, the effects are summarized in the table below.

Every precaution has been taken to exclude every other influence except the single one of alcohol. In this respect the guinea-pigs have had an advantage over alcoholized humans, for they have escaped stomach complications by receiving the poison by inhalation instead of by the mouth.

It was found early in the work that when given by the stomach, alcohol caused digestive disorders that would affect the nutrition and thus prevent a clear picture of the effects of the alcohol alone. This was avoided by the inhalation method.

With animals, therefore, that showed no indication of departure from health, either in their behavior, or in their cells and tissues under post-mortem examination with the microscope, Dr. Stockard has obtained a record that cannot be overlooked by anyone discussing the question of alcoholic heredity.

1. Archives of Internal Medicine. Oct., 1912.
2. The American Naturalist. Nov., 1913.

Condition of the Offspring from Guinea-Pigs Treated With Alcohol

Conditions of Animals	Number of Matings	Negative Result or Early Abortion	Stillborn Litters	Number of Still-born Young	Living Litters	Young Dying Soon After Birth	Surviving Young
Alcoholic male by normal female	59	25	8	15	26	21	33
Normal male by alcoholic female	15	3	3	9	9	9	10
Alcoholic male by alcoholic female	29	15	3	6	11	7	9
Summary	103	43	14	30	46	37	52
Normal male by normal female	35	2	1	4	32	4	56
Second generation (from alcoholic parent) by normal female	3	0	0	0	3	0	4
Second generation (alcoholic parent) by alcoholic female	3	0	2	5 1 def't'e	1	0	2
Second generation male by second generation female	19	7	0	0	12	6 1 def't'e	13
Female treated during pregnancy (normal previous)	4	0	0	0	4	1	7

From the preceding table prepared by Dr. Stockard, the following table has been compiled to show percentages.

Results of Mating in Averages and Percentages

Condition of Parents	Number of Matings	Average Young per Mating	Percentage of Failures or Early Abortions	Percentage of Still-born or Dying Soon After Birth	Percentage of Survivals
1 Alcoholic male by normal female	59	1.1	42 pct.	53 pct.	47 pct.
2 Normal male by alcoholic female	15	1.8	20 pct.	64.3 pct.	35.7 pct.
3 Alcoholic male by alcoholic female	29	.7	57.7 pct.	59 pct.	41 pct.
4 Summary	103	1.1	41.7 pct.	56.5 pct.	43.7 pct.
5 Normal male by normal female	35	1.8	5.7 pct.	12.5 pct.	87.5 pct.
6 Second generation* male by normal female	3	1.3	0	0	100 pct.
7 Second generation male by alcoholic female	3	2.3	0	71.4 pct.	28 pct.
8 Second generation male by second generation female	19	1	37 pct.	31.6 pct.	68.4 pct.
9 Female—treated during pregnancy	4	2	0	25 pct.	75 pct.

It should be noted* that the number of matings of second generation fathers with normal and with alcoholic mothers, respectively, is very small, only

three in each case. For this reason, no sweeping conclusions can be safely drawn, yet it is well to note the marked tendency toward restoration when normal males are mated with descendants of alcoholic parents, which themselves received no alcohol. "It might seem," says Dr. Stockard, "as though the normal male counteracted any defect that may have been present in the second generation animals."

On the other hand, when the tainted stock is mated with freshly alcoholized partners, no sign of restoration, but evidence of further degeneracy is apparent.

Again, there is small indication of restoration when the tainted second generation males and females are mated together (8), although they received no alcohol themselves. There are enough of these matings, 19 in all, to furnish a basis for comparison. While the percentage of those born that survived compares favorably with that of the directly alcoholized father or mother (1) and (2), the fertility is lower than that of any other class except the alcoholics by alcoholics (3).

Dr. Stockard says on this point:

"The actual physiological proof of the efficiency of the organs is shown by the ability of the animals to reproduce. Although there is no visible structural change in the germ cells, nevertheless, they have been modified by the treatment to an extent sufficient to cause them in most cases to give rise to defective embryos or weakened individuals which die soon after birth."

Individual Cases

From a table which Dr. Stockard gives of the results of successive mating of 15 females an interesting study can be made of individual cases. Each animal, male and female, is therein designated by number, with the information as to whether alcoholic or normal. One important point to keep in mind is that before any of the guinea-pigs received alcohol they were all tested by normal mating and found to give normal offspring. Another is the author's statement that the animals treated "continued to give normal offspring until the treatment had lasted for some time. The effect accumulated slowly and was not noticed at once."

Number Five, one of the alcoholized animals that at the time the American Naturalist article was written, had been treated with alcohol for two and a half years, outwardly appeared to be entirely healthy. He had been mated 25 times and 11 of the matings, seven of which were with normal females, had produced no results. This alone showed a marked contrast with the records of normal males, for with them failures were very rare, especially when mated with normal females. Out of the whole 35 normal matings recorded, that is, where both parents were normal, there were only two failures to produce litters.

Three of the 25 matings of Number Five resulted in still-born young, two when the mothers were normal, one when she was an alcoholic.

On the other hand, among the 35 matings of wholly normal animals, only one litter was still-born and that was an unusually large one of four individuals, which appeared to be too much for the mother to sustain.

Eleven of the 25 matings of Number Five resulted in living litters, four of which died soon after birth, and only seven (litters) survived.

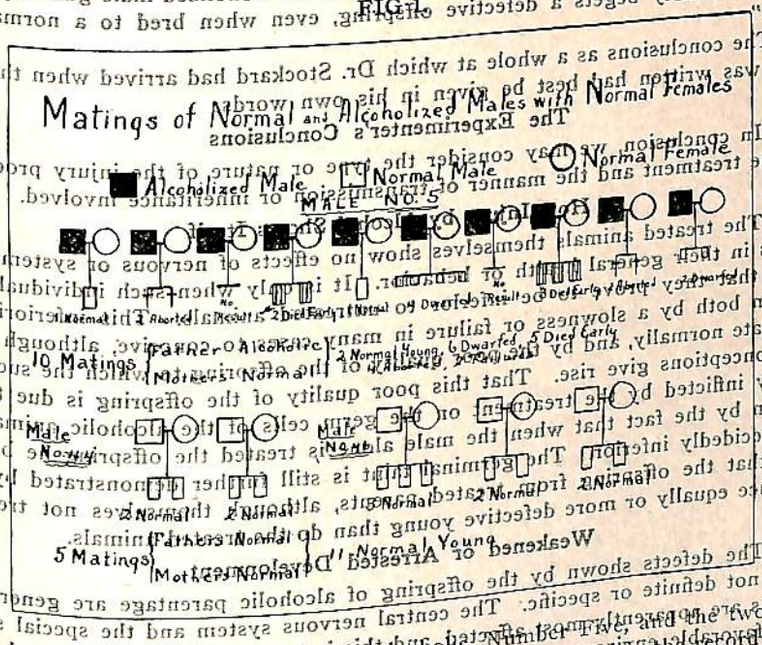
Of the 32 living litters of the normal animals, 60 individuals in all, only four young died.

Another of the alcoholized males, Number Six, furnished a record that was even worse than that of Number Five. Out of 21 matings, 10 gave negative results, two litters were still-born, five litters were living when born, but died soon after. Of the four surviving litters, two were composed of members recorded as small or "one-half size."

The worst condition of the progeny of the alcoholized fathers existed in those whose mothers were also alcoholic. This was, of course, to be expected, for even the normal males had unhealthy young when paired with alcoholic females.

Figure 1 is an attempt to represent graphically the matings of Number Five with normal female and, for comparison, five matings of two normal males also with normal females. It would have been preferable to represent an equal number of matings of one normal male, but the data was not obtainable from the records.

FIG. 1.



The grandchildren of Number Five showed even worse conditions than those of his immediate progeny, especially when both the parents of these grandchildren had been bred from alcoholized animals. Undersize, tremors, convulsions, weakness, excitability and deformity were the lot of these unfortunate grandchildren, although their own fathers and mothers received no alcohol. No such defects appear in the grandchildren of the wholly normal animals.

Dr. Stockard is not afraid to handle the debated question, which comes first, the alcoholic or the degenerate. Referring to the Schweighofer woman who had three sound children by a healthy first husband, then three degenerate chil-

dren by a drunken second husband, and afterwards two healthy children from a sober third husband, he says:

"A number of such cases are on record, but all are open to the question whether the defective offspring are actually due to the effects of the poison on the parent, or to the fact that the parent may have been weak and dgenerate from the beginning.

"Other substances than alcohol seem to act directly on the germ cells of man and mammals, and these actions are more important since there is no reason to believe, for some of them at any rate, that they accompany a degenerate condition. Constantine Paul long ago pointed out that the children of lead workers were often defective. He made the observation that when the father alone was employed in such work his children were affected."

The results of his own experiments, Dr. Stockard says, "have demonstrated several significant points and have shown that an alcoholized male guinea-pig almost invariably begets a defective offspring, even when bred to a normal female."

The conclusions as a whole at which Dr. Stockard had arrived when this article was written had best be given in his own words:

The Experimenter's Conclusions

"In conclusion, we may consider the type or nature of the injury produced by the treatment and the manner of transmission or inheritance involved.

How Injury by Alcohol Shows Itself

"The treated animals themselves show no effects of nervous or systemic injuries in their general health or behavior. It is only when such individuals are bred that they prove to be inferior to untreated animals. This inferiority is shown both by a slowness or failure in many cases to conceive, although they copulate normally, and by the poor quality of the offspring to which the successful conceptions give rise. That this poor quality of the offspring is due to an injury inflicted by the treatment on the germ cells of the alcoholic animals is shown by the fact that when the male alone is treated the offspring he begets are decidedly inferior. The germinal taint is still further demonstrated by the fact that the offspring from treated parents, although themselves not treated, produce equally or more defective young than do the treated animals.

Weakened or Arrested Development

"The defects shown by the offspring of alcoholic parentage are general in type, not definite or specific. The central nervous system and the special sense organs are apparently most affected, and this is true also in embryos developing in unfavorable environments. I have found that fish embryos when developed in a large number of unusual environments, including alcohol and ether, always show marked abnormalities of the nervous system and special sense organs, particularly of the eyes and ears. When chick embryos are subjected to similar environmental conditions, it has been found in experiments performed during the last two winters, that they respond in a manner similar to the fish. Many chick embryos show different degrees of cyclopia and the degeneration or absence of one eye of the normal pair is a common defect in the chick as it is in the fish where many grades of monophthalmicum asymmetricum were described in my communications on the subject. In this connection, the eyeless guinea-pig derived from untreated animals that had an alcoholic father becomes of special interest, and the general nervous symptoms, spasms, epileptic-like seizures, etc., shown by animals of two generations gain importance.

"All defects of the nature of those mentioned may be considered as due to weakened development or developmental arrest. Any environment that weakens or retards the early stages of development will cause such conditions. How, then, are they transmitted by the alcoholic male, or by the untreated offspring of alcoholic parentage.

How Injury Is Transmitted

"When the animal is treated with alcohol, lead, or almost any poison for a long period of time, the poison acts to weaken or injure all of the body tissues with which it comes in contact through the circulation, the liver and other glandular organs usually show the effects in particular. The reproductive glands are injured as well as others and all the cells and tissues of such an organ are below normal. When such a male animal is paired with a normal female, the resulting offspring contains in every cell of its body elements derived from the weak or injured pro-nucleus. Unless the vigor of the normal parent is sufficient to overcome the injured condition, the offspring is defective.

"The important thing in considering this defective offspring is the recognition of the fact that not only its soma cells, but its germ cells as well, are defective, since all were derived from the modified spermatozoon of the injured father. When this offspring with injured germ cells is paired with a similar individual, as has been frequently done in the experiments described, the resulting animal body is constituted of cells, all of which are the result of proliferation or division from the primary injured egg and sperm cell; thus all of the cells are of a similar inferior nature. Therefore, the young derived from the second generation should be, leaving out of consideration the power of the cell to recover from such poisoning, equally as defective as those derived from the treated parents.

Weakened Cells Give Rise to Weakened Cells

"This might be construed to show the transmission of acquired characters, but it cannot be properly interpreted in such a sense. There is in this case no transmission of new or strange characters strictly speaking, merely a weakened or injured cell gives rise to other weak cells. The term 'weak' is employed for the lack of a better one, meaning that the cells are below normal in reaction, respond slowly or in a deranged manner, and often die or wear out early in their career.

"It may be that in nature such defects as hare-lip and cleft-palate are transmitted in a fashion similar to the method just suggested. These defects run in families and are said to be inherited. Their character, however, is clearly that of a developmental arrest. Such defects are very probably not truly inherited at all, that is, they are not definite characters or qualities as hair and eye color are, but are due to the fact that the germ cells from which the deformed individual arose, or the uterine environment in which it developed, were not fully normal in vigor. A more careful study of the inheritance of such defects will doubtless reveal the fact that other deformities and developmental arrests are also common in the same families. In other words, weak germ cells or the poor developmental environment runs in the family, and hare-lip and cleft-palate are merely the external expresisons of these conditions.

How an Impaired Family Line May Be Restored

"The interpretation may be concretely expressed as follows: Mammals treated with injurious substances, such as alcohol, ether, lead, etc., suffer from the treatments by having the tissues of their bodies injured. When the reproduc-

tive glands and germ cells become injured in this way they give rise to offspring showing weak and degenerate conditions of a general nature, and every cell of these offspring having been derived from the injured egg or sperm cell are necessarily similarly injured, and can only give rise to other injured cells and thus the next generation of offspring are equally weak and injured, and so on. The only hope for such a line of individuals is that it can be crossed by normal stock, in which case the vigor of the normal germ cell in the combination may counteract, or at any rate reduce, the extent of injury in the body cells of the resulting animal. By continually introducing normal mates into such a line the defects may be entirely eliminated, but the continued inbreeding of animals with defects or systemic injuries will doubtless result in the death of the race. When such a male animal is paired with a normal female, the offspring both of a diseased father derives all of its cells from the poor sperm, thus each cell is poor in part and is so passed from generation to generation.

The present experiments are being continued and a large number of matings between second and third generation animals are now made. Various combinations of second generation animals are being tried in order to compare the effects resulting from paternal and maternal treatments, as well as the double effects. Two animals, both derived from alcoholic fathers, are mated, others from alcoholic mothers, and the various crosses between these classes are tried. In other cases, second generation sisters are mated; one with a normal and the other with an alcoholic male, and subsequently these matings will be reversed in order to study the power of the normal male to counteract the injured condition as well as the tendency of new alcoholic cells to augment the condition."

EXPERIMENTS WITH THE THIRD AND FOURTH GENERATIONS

In 1914 Dr. Stockard published* a report of further experiments. The experiments had then been continued almost four years and, in the words of the experimenter, had demonstrated the fact that the germ-cells of male guinea-pigs can be so injured by allowing the animals to inhale the fumes of alcohol that they give rise to defective offspring, even though mated with vigorous, untreated females."

The latest report gives the condition of the progeny of the original alcoholized animals as far as the fourth generation, the descendants of the alcoholized animals being themselves not treated with alcohol.

The number of matings of second generation guinea-pigs, that is, of the sons and daughters of the animals that received alcohol here, is 95. The average of surviving young is about .5 of an animal per mating. But the rate differs widely, according to whether it is the tainted son or the tainted daughter that is paired with a normal mate.

The average survivals from 11 matings of tainted sons with normal females is 0.8; but from 15 matings of tainted daughters with normal males the average of surviving young is only 0.2 per mating.

In this generation, the third, marked eye defects appeared in, about 17 per cent of the young born at full term.

Conditions Worst in Fourth Generation

A few of the third generation have been mated and their progeny show much worse conditions of degeneracy than any of the others. Out of six matings only one survived, an average of about .01 of an animal to the mating. Here also are marked eye defects. Of four animals that died soon after birth, two were completely eyeless. None of their predecessors had received alcohol except their great grandfathers.

Thus the damage done by alcohol to the animals that received it showed itself in their descendants through three generations in (1) an abnormal degree of sterility, (2) an abnormal number of young unable to live, and (3) abnormal eye development. This last defect did not show itself until the third and fourth generations.

Dr. Stockard has thus produced abundant support for his assertion that the germ cells of male guinea-pigs can be so injured by allowing the animal to inhale the fumes of alcohol that they give rise to defective offspring, although mated with vigorous untreated females, and, that the effect of this injury is conveyed through their descendants for at least three generations.

Dr. Stockard refers at the close of his article to a series of still more crucial experiments by Cole and Davis (Science, 1914), in which it was proved absolutely that the germ cells of the alcoholized rabbits were actually weakened or disabled by the administration of alcohol by inhalation.

* Science, N. S. XXXIX., 1914.

THE

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OF

THE SCIENTIFIC TEMPERANCE FEDERATION

BOSTON, MASSACHUSETTS

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